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Urbana, Ill. June 14–18, 1954

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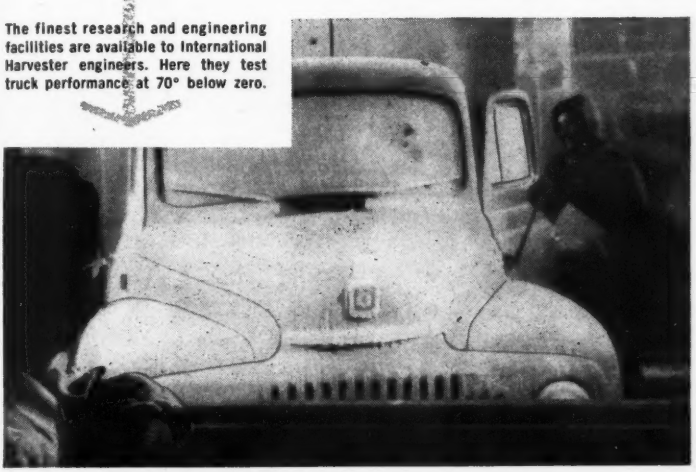

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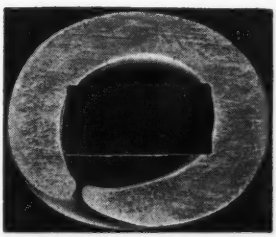
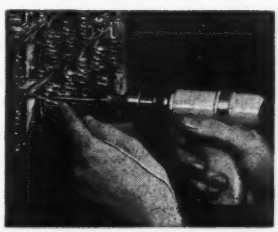


Cross section of solderless connection. Note terminal biting into wire. In a six-turn connection there are at least 20 clean contact areas impervious to moisture and corrosive gases, and offering a low resistance path for current.



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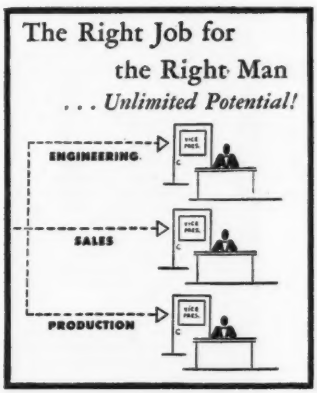

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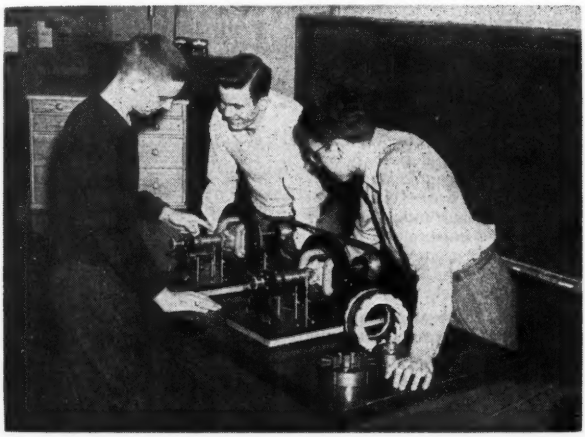

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Keeping Abreast of Advancing Frontiers

A proposal for a new type of Summer Institute

By ARTHUR BRONWELL

Secretary of ASEE and Professor of Electrical Engineering, Northwestern University

Since 1927, the ASEE has sponsored summer schools for engineering teachers. These summer schools have dealt across the board with the subject matter in a given curriculum. For the most part, they have avoided detailed examination of subject matter in specific subject areas. These summer schools have proven highly successful in providing a forum for discussions relating to the broader aspects of the organization and development of curricular material, as well as the improvement of teaching methods. The summer school program has contributed in a very significant way to the improvement of teaching in engineering colleges and it should be continued in the future.

Experience has amply demonstrated that great strides in engineering are often made by reducing to practice new concepts of science and technology. Many areas of engineering education today, including much of electronics, chemical engineering, metallurgy, and engineering mechanics, were at the frontiers of pure science a generation ago. The process of assessment of subject matter, simplificaton for teaching purposes, and revision of engineering curricula has been a continuous one ever since the beginning of engineering education. It seems evident that at a time when science and technology are advancing at a more rapid rate than ever before, it is all the more imperative that this process of assessment and revision be continued. It is the responsibility of the engineer to assure maximum progress in the development of the art of engineering. The rate of progress of engineering depends in no small way upon the ability of the engineer to comprehend new advances in scientific and technological knowledge and to reduce these to engineering practice.

In the past fifteen years, there have been many instances in which substantial revisions in curricular subject matter have come about as a result of conferences of a comprehensive nature in specialized technical areas. In many cases, because of their highly specialized character, these conferences would not have been regarded as suitable for ASEE sponsored summer schools. But it was often this specialized character which made it possible to explore a restricted area with a high degree of penetration and to achieve therefrom a clarification of the underlying scientific and analytical principles. This is the first and most important stage in making an intelligent appraisal for curricular revision. This process of assessment of a new field, seeking out the fundamental concepts, and trying to determine, with a reasonable degree of balance, where and how it should fit into an already overcrowded curriculum is not an easy one. In this process, much can be gained by bringing the divergent viewpoints of the research engineer, the scientist, and the educator to bear upon the problem.

As an example of a technical conference which has exerted a profound influence upon undergraduate curricular organization, one can cite the conference on Advanced Electronics, held some years ago at the University of Michigan. This was an intensive investigation into what at that time constituted the frontiers of sci-

ence, including such subjects as gaseous discharge, energy states in atoms and behavior of electric charges in fields. This conference was instrumental in helping to produce a complete reorientation of the electronics curriculum along more fundamental lines.

During World War II, a seminar at MIT in an entirely new field, Ultra High Frequencies, resulted within a few years in a substantial revision of the undergraduate subject matter in communications and the introduction of Maxwell's equations as a fundamental basis of building concepts. For the first time, many electrical engineering teachers began to realize the extremely limited application of certain concepts which they had previously regarded as "extremely fundamental." Similar examples could no doubt be cited in numerous specialized areas of Civil Engineering, Mechanical Engineering, Chemical Engineering, and others where the technologies are moving rapidly ahead.

This situation raises the vital question, should ASEE develop a program of technical conferences which will penetrate more deeply into the frontiers of science and technology and which will evaluate, assess, determine interrelationships, and seek to revise curricula in accordance with modern needs? If we take the viewpoint that a deeper penetration into the more advanced technical areas is not the proper domain of ASEE, then it would follow that this function would revert to the technical engineering societies and it would be these societies, not ASEE, which would carve the future of engineering education. It seems evident that this role of assessing new areas of technology which are moving rapidly into modern engineering practice is one of the most vital functions of ASEE. It is the function which will determine whether engineering education will be dynamic or static.

This suggests the possibility of developing a forward-looking program of conferences, sponsored by the Divisions and Committees of ASEE. The purpose of these conferences would be to identify those areas of science and technology which are likely to be translated into significant engineering practice in the years ahead. The conferences would seek a deeper penetration of subject matter in order to clarify and systematize the underlying fundamental principles and evaluate them for teaching purposes. They would project ahead and seek to evaluate trends and probable future developments. They would also explore matters of organization of subject matter for teaching purposes as well as teaching methods.

Such conferences should be concerned only with those areas which are sufficiently fundamental in character as to merit serious consideration for undergraduate and graduate instruction purposes. The more specialized technical developments which do not open up whole new areas of fundamental principles are still the proper domain of the technical societies. However, there are promising possibilities of arranging conferences which seek to unify broad areas of the existing engineering curriculum. Such fields as heat flow, electric field theory, fluid flow, and vibration theory have a common base in their analytical methods. A conference seeking greater unity in the teaching methods in such fields might prove highly profitable.

This proposal was approved in general principle by the General Council of ASEE on June 26, 1953. The Council voted to authorize the appointment of a Committee of ASEE to study the proposal and take steps toward its implementation. The Council suggested that conferences of this nature should be a minimum of one week's duration. A number of engineering colleges have indicated their desire to sponsor such conferences jointly with the ASEE Divisions and provide campus facilities.

Several areas of possible future conferences have been suggested. These include: fundamental concepts of nuclear

transformations and nuclear energy; thermodynamics from the viewpoint of the physicist, the chemical engineer, and the mechanical engineer; solid state physics (including such subjects as transitors, metallography, etc.); unification in the teaching of analytical methods in heat flow, fluid flow, vibration, and electromagnetic theory; plastic flow in structures; and the teaching of advanced physics to engineering students.

It is clearly recognized that the scientific-technological stem is only one phase of engineering education and that a similar program should be developed for improvement of the social science and humanities courses. The Humanistic-Social Division of the Society has prepared a preliminary proposal for a comprehensive study in their areas and the Executive Board is currently working with the Division on its implementation.

Enlightenment is the first prerequisite to intelligent curriculum planning. By inaugurating this series of conferences, the ASEE hopes to stimulate soundly-conceived and forward-looking programs of curriculum planning which will contribute substantially to the advancement of engineering education.

ANNUAL MEETING

June 14-18, 1954

University of Illinois **Urbana, Illinois**

Do You Know—

► Strictly personal—to young engineering teachers—this issue of the Journal contains the new rules for the YET Paper Contest. Last year's two prize-winning papers are published in this issue. Here is a distinctive opportunity to express your ideas and win national distinction. Good luck!

► This issue also contains a list of Chairmen of Divisions, Sections and Committees of the Society. General Council members are always listed on page two. If you are interested in submitting a paper for the June convention, please contact the appropriate Chairman.

► The Fall meetings of ASEE and ECPD, October 14–17 at New York opened up challenging new subjects. The ASEE program dealt with creative thinking. In the morning, a music critic and composer, Virgil Thompson; a painter, John Ferran and a literary man, Ralph Bates, dissected the subject of creative thinking from their respective viewpoints. A psychologist, Dr. Stein, presented a discussion of the mental processes involved in creative thought at lunch. Finally, two research administrators, Maurice Nelles of Borg-Warner and Fred Olsen of Olin Industries, tackled the subject from industry's viewpoint. This conference brought out some of the many challenging facets of this subject.

► A brief statement describing the George Westinghouse and Lamme awards is printed in this issue of the Journal. Brochures describing the awards more fully and nomination forms can be obtained from the Secretary. Nominations should be submitted before February 1, 1954, to the Chairman of the Award Committee.

► A statement by President Grinter on the proposal to increase the ASEE dues will be published in the November issue of the Journal. The September issue of the Journal carried the report of the Committee on Society Finances, the recommendations of which were adopted by the General Council last June. This issue contains the financial report and budget for next year.

The Society has only one staff member for every 1500 members. There is probably no other learned or professional society of comparable membership and scope of activities in the United States which operates with this small a headquarters staff. This is a tribute to the excellent work of the officers of the Divisions, Sections and Councils, who have accepted the responsibility for their part in the Society's operations. The Society has been successful in staving off deficits by devoting a great deal of effort to expanding membership, obtaining increased advertising and enlarging other sources of revenue. But this also entails added costs of operation which offset part of the increased income. It seems difficult to escape the fact that the dues per member today are worth little more than one-half of their value in 1946.

► The College-Industry Conference of the Relations With Industry Division will be held this year at the University of Detroit on January 16, 1954. The theme will deal with post-college education of the engineer. This conference presents subjects of widespread interest to industrialists and engineering educators.

► A great many platitudes have been eloquently delivered on the need for developing ingenuity and originality in engineering education, without sacrificing quality. Now we need a few concrete examples of teaching which achieves this objective. If you know of somebody who is doing an exceptional job, urge him to write it up for the Journal. These articles should be concise and to the point. Hold them down to two printed pages, so that we can include a number of different examples.

► Also, we need more *good* material on effective teaching techniques for our "Timely Tips" section of the Journal. These should preferably be directed at making difficult concepts sound simple. If you have something you would like to submit, send it to the Secretary. It should not exceed one or two printed pages; also, not too many photos please!

► A useful and revealing report of the ECAC Manpower Committee, projecting the supply of engineering graduates ahead and including the effects of ROTC, draft calls and returning veterans will be published in the November issue of the Journal. Watch for it.

► The Educational Methods Division has recommended that more emphasis be devoted to objective research in engineering education. This recommendation is worthy of serious consideration by the ASEE Divisions.

► If you have a notice of important ASEE activities for this section, in capsule form, please send it to me and we will try to get it into the Journal.

Best Regards,

ARTHUR BRONWELL, *Secretary*

College Notes

Gordon B. Carson has assumed the Deanship of the College of Engineering at **Ohio State University.** This position was formerly held by the late Charles E. MacQuigg, Past President of ASEE.

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Dr. Robert C. Disque, Dean of the Faculty and since 1933 Dean of the College of Engineering of **Drexel Institute of Technology,** retired August 31, and Professor Harry L. Bowman, head of the department of civil engineering, succeeded him in both posts.

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The American Society of Civil Engineers has announced the election of Daniel V. Terrell, of Lexington, Ky., as President. He is Dean of the College of Engineering, **University of Kentucky.** Dean Terrell, who will succeed Walter L. Huber of San Francisco, was installed Oct. 21 at the Society's annual meeting, held in the Statler Hotel, New York. He will serve one year.

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Professor Victor M. Ganzer has been appointed Executive Officer, Department of Aeronautical Engineering, **University of Washington.** He has been the acting head of the department during the past year following the resignation of Professor Fred Eastman because of ill health.

Improving the Product*

By LEE HARRISBERGER

Assistant Professor of Mechanical Engineering, University of Utah

When a young engineering instructor sets himself to the task of speaking about changes and improvements that he feels should be made in engineering education, he very soon wonders if he is not just a little pup barking at the heels of a stoic old St. Bernard. However, the greatest asset he has is a rip-roaring enthusiasm to try something new. It is also fortunate that this enthusiasm is undimmed by the conservative caution born of age and experience.

Every young instructor is prompted to crusade for improvement within his own college because of his natural revolt against the traditions and common practice that inevitably exist. He wants to change the text which has been in use for several years. He wants to write new laboratory experiments, buy new types of laboratory instruments and install new equipment. He thinks the classrooms ought to have better lighting and more demonstration equipment. He would like to see more faculty seminars and committees and an active promotion campaign for his college. As he grows older in the business of teaching, he sees that budgets do not permit sweeping improvements in laboratories and facilities, that seminars and committees are interruptions to a comfortable teaching routine. It is fortunate indeed that every faculty is subjected to a perennial crop of enthusiastic young instructors.

Because the young instructor is receptive to new ideas, he is for the most part a close reader of the journals and business magazines that publish articles of concern for the graduating engineer. Often he is selected to be the faculty chairman of the student engineering organizations and honorary fraternities. In these organizations, he enjoys a closer and more informal relationship with the student than many older faculty members enjoy. Students are quickly drawn toward a friendly association with a faculty member nearer their own age. Thus, they frequently volunteer their thoughts, opinions and criticisms of the faculty, the curriculum and its administration. In this environment of criticism from students, educators, technical associations and societies, and industry, the conscientious young instructor cannot help but feel that engineering education is not developing a product for the market.

Our engineering colleges are currently enjoying a "seller's market" and will for several years to come. Our senior engineering classes are entirely hired at "relatively fabulous" beginning salaries many weeks before graduation. This prosperity in the business world would not prompt too much concern over the quality of the product. Yet, even though industry is hiring our graduates with a starvation appetite, a great many industrial leaders as well as engineering educators and many of our students are voicing an increasing volley of comments about the competence of our graduates either technically, professionally or socially.

What are some of the things that are wrong with our production and our product? Louis Bromfield, in a recent magazine article, complains that colleges are granting degrees without education. Col-

* This paper won first prize in the Y.E.T. contest.

lege graduates are woefully lacking in grammatical competence, seriously limited in a broad interest of the arts, literature, or social problems. He states that spot surveys show that a very small percentage of university students are interested in an education—most are in college because of parental insistence, degree prestige, or because of the positions degrees will obtain.

The personnel director of a large industrial concern once commented before an engineering student body that his company was not interested in what the student had learned. He stated, much to the amusement of the students present, that everyone knew that the student was getting out-of-date information from out-of-date texts taught by out-of-date professors. His contention was that a degree in engineering merely signified that the student was capable of learning what his company was prepared to teach them. The main thing his company was concerned with was whether the candidate showed an ability to cooperate and get along with his associates.

Some of the larger companies have extensive training programs extending for several years to which they subject the new graduates. Some of the programs are linked with some of our graduate schools in engineering or have their own company-sponsored night schools. More and more we see the trend of industries involved in advanced research projects, such as rockets or atomic energy, in their hiring of new graduates. We find that they prefer graduates in physics or physical chemistry to engineers for their top technology positions. They are hiring engineering graduates for equipment application and design or production work. These activities and attitudes are a bold indication that our larger progressive industries give very little credit to our engineering colleges.

Among our colleges we find a concern for the type of course we offer. There is the concern that four years is not enough time. Some believe we should adopt a five year engineering course for a bachelor's degree. In some schools we find a trend toward generalization, eliminating several types of engineering and requiring more social and humanities courses. In other schools there is the trend toward more specialization. Many different degrees in engineering are being offered. There are combined programs offering a B.S. degree in engineering and a B.A. degree in business at the end of five years. There is the cooperative plan whereby an undergraduate is hired by a local company to work summers and part-time while he pursues his studies. All are attempts to close the widening gap between industrial demand and university product. Most, however, aim at the effect rather than the causes.

Educators are also showing their concern for the quality of the product by criticising the educational program. There is criticism of mathematics in engineering. One article commented that the list of courses in mathematics, almost universally required, has not changed in twenty-five years. A recent survey showed that most engineering students must repeat much of their high school mathematics. There has been criticism that there is too much redundancy in our courses in the treatment of physics fundamentals. There is comment that too much time is spent in trade courses such as drafting, surveying, and shopwork.

There is concern among educators for the faculty. Some feel that the faculty should do more research—bring in more contracts. Others feel that the faculty should spend more time on the business of teaching. The American Society for Engineering Education recently appointed a national committee to study means of encouraging faculty members to turn their energies to improving their teaching. Faculty members are being encouraged to obtain advanced degrees. Other educators feel that engineering faculties should encourage industry to provide them with summer work and on-the-spot periodical industrial indoctrination.

Every member of an engineering faculty

can testify that the methods of teaching within engineering courses are to a large degree "by-the-seat-of-the-pants." Most of us learned to conduct a class by remembering how our own classes were taught and by following the advice of our elders. We improved only by experience at the cost to the students. It is a rare case indeed that a member of an engineering faculty has any formal training in the aspects of teaching. As a result we find that our courses are canned, our examples are often idealized, the content is filled with repetition and childish drill, our lectures often show our mastery of the complicated and little thought for the difficulty of comprehension. We direct the student in his thought processes. We make him lean on us. Our examinations encourage memory and signify the end of a trial.

Even though science has expanded one thousand fold, our curriculum has not changed enough since the beginning of the century. Our student is subjected to a four-year routine in which he is told to take a prescribed list of courses in a prescribed order. In most cases he is allowed only his choice of a few hours of electives, sometimes less than 10% of his credit. Our efforts to balance sections and faculty loads each term to a large extent dictate when the student will section his courses.

We find that our students have for the most part become slaves to credit. It is a natural tendency to "beat-the-rap" when subjected to a dictated routine. The student's concern is to get his required number of hours for his degree with the least amount of effort. He complains frequently that laboratory courses do not have enough credit. He frequently petitions for credit for any practical experience he may have gained in part-time employment. In general, he is seeking a degree rather than an education.

Basically, then, our problem is one of trying to develop a flexible educational program which not only meets the demands of technology today but one which will continue to keep up with the terrific advancement ahead. It must include a program of development for the staff. Above all, it must create an environment for the student which will develop confidence in his training, a mature professional attitude, and a thirst for learning.

Now, what is needed for the production of a graduate that will meet the demands of the market? We need to provide a much broader background in the expanding area of scientific fundamentals. We must install an extended field in the applied mathematical language of science. We need a program of self-initiated undergraduate research and design. We need a program of "free-seminars" which would encourage thoughts and ideas both in technical and nontechnical areas. We need stronger preparation in the high schools. We need a closer working relationship between education and industry. This is a tall order but one that must be met entirely, not just partially.

This program would inevitably necessitate a major upheavel of our entire present system of engineering education. It would require a revision of the methods and philosophies of every instructor. It would call for a revision of approach and content of each system of courses in all our service departments such as Mathematics, Physics, and Chemistry. It would even lead to a revision of the role our high schools and preparatory schools play in pre-college training.

Many good schemes have been proposed by various educators recently for developing one or more of the desired aspects. A need such as outlined here must incorporate the best of many of these proposals. It is not the purpose of this paper to develop the operational and functional details necessary to revamp a typical college of engineering. It is doubtful that one person could. However, a general philosophy of the scope of operation necessary to fulfill the purpose can be outlined.

We first must initiate within the secondary schools a mature preparatory course

for pre-engineering students. That is, we must very definitely specify and demand a raw product that will meet the requirements our system of education will make. We must give back to the secondary schools the elementary foundation courses of our first years in engineering and insist that their graduates meet our standards. Much of our first year in engineering is spent re-teaching every course taken in high school, such as algebra, trigonometry, mechanical drawing, chemistry, physics, English and grammar, and the social sciences. Redundancy and inefficiency are cell mates.

The first major criticism here would be that too many students come from small rural schools where they could not get this sort of training. Here is where the sectional junior colleges would play their role. No institution is better equipped to be an engineering college preparatory school. The high school students who could not meet the entrance requirements in engineering would enroll in a junior college for the deficiencies.

With the freshman year's subjects virtually eliminated from the curriculum, the way is clear to devote two full years to a much extended foundation in engineering science. The way is clear to begin mathematics with analytics and calculus the first year. During the second year an advanced applied mathematics course covering such items as Fourier Series, Laplace Transform, Statistical Analysis, Nomograms, and Differential Equations should be offered. The student would be taking advanced physics and chemistry including nuclear physics the first year. During the second year, revised foundation courses in applied engineering science should be introduced, such as: courses in mechanics, thermodynamics, electricity and electronics, fluid mechanics, metallurgy, etc. All of these courses should be devoid of the techniques of specialized design applications. The student should be placed in a position to learn to understand the association of the basic laws to the field. He should not be made to feel that his success depends on how well he has memorized the techniques of applying the developed formulas.

During the first two years, there should be time for the addition of courses which develop the capacity of the mind to cope with ideas both philosophically and geometrically. Practical courses in philosophy, psychology, logic and reasoning along with descriptive geometry, speech, technical writing, and elements of visual presentation through charts, graphs, symbols, curve plotting and tabulation should be available. The curriculum would necessarily be specified for the student during these two years with the exception of possibly 15% of his credits allotted to non-technical electives.

This general outline of curriculum content for the first two years illustrates one important point. The student would be subjected to a mature diet of the fundamentals of science and reasoning. These courses would be taught with the idea that the most important thing for the student is to acquire the ability to reason and analyze. It is important to notice that no mention was made of the breakdown into specialties or options. The fundamentals taught are common to all branches of application.

Following these two years of basic preparation would be the period of maturity for the student. During the junior and senior years the student would be given a great deal of freedom. There would be no specified curriculum, no specified number of credit hours required for each term. Only general requirements would be met. That is, the student would be required to meet a credit requirement for these two years which would include a certain percentage in his major, a certain percentage in a minor and a certain percentage within a broad field of non-technical humanities or cultural courses. Whatever curriculum he would follow would be one of his choosing as approved by his counselor.

The student's major should be selected within three general areas. Professor

King of U.C.L.A. proposed a very good plan for the designation of these areas of specialization: technical research, production and design, and sales or management. For example, students selecting the general major of technical research would plan a series of courses in a field of advanced technology with, say, 60% of his credits devoted to advanced courses in basic sciences and his minor interest, 25% of his credits devoted to self-initiated research projects and seminar participation and 15% to cultural subjects. In the production and design area he would devote, for example, 70% of his credits to his major and minor, 15% to self-initiated design projects, and 15% to humanities. In the management or sales area, a breakdown could be made whereby he devotes 45% of his credits to an engineering major, 40% to courses in management, business, and engineering economics, and 15% to humanities. In all cases the student should be encouraged to avail himself of the most knowledge he can possibly acquire during the time he is in college. All students should be advised to carry all that the "traffic will bear." The brilliant student should not be inhibited by restrictions in number of hours he must carry at any one time. Initiative and industriousness should be encouraged.

It is obvious that the freedom allotted to the student will set up a natural system of gravitation. Each student will gravitate to a level according to his ability. Those who set out to achieve the highest degree of accomplishment in coverage of a chosen field should be awarded some recognition on their degree.

With all students developing their own curriculums it would appear that scheduling and assignment of classes by various departments would be impossible. Critics would proclaim that sectioning would be thrown into chaos. Not necessarily so. At some advanced date the college could require that each student post his course intentions for the next two terms. The schedule for each term would be built around the demand. The innovation here is that the college will schedule its courses for the student instead of scheduling the student for its courses.

The prime requisite of our graduate to meet our ever expanding technology is confidence in his background and mature judgment in his approach to his future. The proposal here is aimed at just that. The student will only grow in confidence and maturity when put to the task. He must see that the responsibility for his training lies entirely with himself. His mastery of his field was founded on his own choice of curriculum and his own initiative in its performance. Assigned schedules, cook book courses, and directed study reduce the student to robot performance and sub-normal attainment.

Freedom of schedule is one large step toward this goal. However the classroom training must be consistant with the aim. Instructors must revise their lecture techniques to eliminate time consuming drill chores. Their courses should inspire curiosity and encourage the student to "go the second mile." Tight schedules of presentation should be eliminated. The content and coverage should be geared to the class demand and always inspiring them to greater heights.

Each engineering college should develop a sound system of in-service training for its faculty. Regular seminars on the improvement of teaching should be required. This sort of thing would be the saving and making of many young instructors and the re-vitalizing of the old timers. These sessions would encourage a uniform philosophy of classroom approach, introduce new lecture techniques and discourage habit-bound lecturers. The faculty should be encouraged to work on advanced degrees. More important is a workable system of encouraging faculty members to work in industry frequently. The scientific competence of the faculty is necessarily important but within many areas of engineering his up-to-date knowledge of the practicing profession is equally as important. It is a sad thing indeed

for a faculty member to direct the activities of a student to prepare him to step into industry with confidence when he himself has not been associated with the field for twenty years.

Finally the student should be assigned to a faculty member during his first term at the college. The counselor would play the role of his "great white father." He would be recognized by the student as his friend, advisor, confidant and inspirator during his entire college career. The faculty's greatest contribution to the successful attainment of the students' engineering endeavor while in college can be made in this capacity.

College Notes

The Iowa Institute of Hydraulic Research at the **State University of Iowa** announces the recent publication of the Proceedings of the Fifth Hydraulics Conference which took place June 9–11, 1952. This Bulletin, No. 34, is devoted entirely to the manifold problems of transport, scour deposition, and measurement of sediment. Contained in this Bulletin are fourteen papers contributed by experts on various phases of this topic, and discussions by those who attended the Conference.

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A program allowing civil engineering students to get a head start toward advanced degrees in law, business and public administration, or regional planning was introduced at **Cornell University** in September. Formerly, after completing Cornell's five-year civil engineering course, a student spent three more years for the law degree or two years for the master's degree in the other fields. Under the new program with the Law School, School of Business and Public Administration, and College of Architecture, a student may obtain both degrees a year sooner. Students will begin the combined program in the fifth year of engineering school by choosing elective courses acceptable to the chosen division and other courses that meet requirements in both areas.

Errata

In the September issue of the JOURNAL OF ENGINEERING EDUCATION under "College Notes" it was stated that a grant of $150.00 to the University of Pittsburgh by the Westinghouse Educational Foundation was made. The grant was for $150,000.

Education for the Engineering Spectrum

By RALPH J. SMITH

Professor and Head, Engineering Department, San José State College

SYNOPSIS

There is an obvious need for improvement in engineering education to keep pace with the growth of engineering. In meeting the need we can raise the entrance requirements, increase the length of the program or reduce the number of objectives per student. By recognizing that engineering is a broad spectrum of activities and organizing our programs to reflect functional preparation, we can provide improved training in line with the requirements of engineering and the aptitudes of students.

In his report on "The Year of Evaluation" Dean Hollister pointed out that engineering curricula have been modified very little in the last forty years. He proposed that we examine carefully our present standard engineering program to determine whether it will serve the coming needs in engineering education. The purpose of this paper is to point out one serious problem facing engineering education, indicate the possible solutions, and suggest how the best solution can be accomplished.

The Problem

We are all aware of the tremendous growth of engineering knowledge and activities. There is an obvious need for improvement in our system of engineering education to keep pace with the growth of engineering. In the past we have attempted to take care of this problem by the introduction of specialization. We split off mechanical engineering from civil engineering, electrical from mechanical engineering and electronics from electrical engineering. In each case we were recognizing the fact that with the growth of engineering the fraction of the total which one man can master becomes smaller and smaller.

Along with the growth of technical knowledge there has been a repeated call for increased breadth of engineering training. We list a tremendous number of objectives for engineering education. Our graduates are to be fully aware of the tradition of past engineering accomplishments, trained in current engineering practice and prepared for keeping up with engineering progress for the next fifty years. They are to have the capacity to design on the highest technical level and to be skilled in human relations with an understanding of the principles of business organization and management. They are to have breadth of training in several engineering fields and, in addition, to possess the specialized knowledge required in their own field of specialization. They are to be proficient in all modes of expression—verbal, graphical and mathematical. On top of all of this we expect them to have a broad education in the humanities. The problem is, how can we set up our engineering training programs to provide an ever increasing number of qualified graduates to meet the ever enlarging demands?

* Second prize winning paper in the Young Engineering Teachers Competition, presented at the Annual Meeting ASEE, Univ. of Florida.

Possible Solutions

There are at least three approaches to the solution of this problem: we can raise the entrance requirements, increase the length of the program, or reduce the number of objectives per student, as suggested by L. E. Grinter.

Raise the entrance requirements

By being more restrictive we can limit entrance into engineering colleges to superior students. These students would be selected on the basis of their ability to learn rapidly and on their demonstrated aptitude for scientific study. This would permit increasing the accomplishment in four years.

An obvious disadvantage of this approach is that we would effectively reduce the number of engineers available. This is directly contrary to the conditions of the problem. Not only do we have a present shortage, but there is need for a steadily increasing number of engineers. As a matter of fact, we must increase the percentage of the total population who are qualified along technical and scientific lines. Any elevation of the entrance requirements would have the opposite result.

Increase the length of the college program

Another possibility would be to go to five- and six-year programs. Assuming, for example, that there is fifty per cent more to be learned, perhaps students should expect to spend fifty per cent more time in college. Would this mean that in another forty years we should go to an eight-year program? Obviously this doesn't make sense.

A college can fill effectively only a certain limited portion of a young man's life. That period is bounded on one side by the fact that to benefit from college instruction a student must have sufficient maturity to set up goals and work on his own initiative. At the other boundary is his psychological need to be gainfully employed, to get married, to start a family and take his place as a contributing member of society. The present four-year period seems to be consistent with the psychological, economic and sociological factors.

Reduce the number of objectives per student

This is an approach which we make use of frequently in engineering. If we wish a device to be efficient we limit the performance expected of it. A general purpose device is usually characterized by being complex, bulky and expensive. The introduction of subject-matter specialization in engineering programs is an illustration of this type of approach. However, it appears that this type of subdivision has reached the point of diminishing returns. There is another approach which, in my opinion, holds great promise. This is specialization by function.

Functional Classification

The classification of engineering into *fields* of chemical, civil, electrical, mechanical, mining and petroleum engineering is in terms of what the engineer works *with*. From the standpoint of training, a much more meaningful subdivision is by *function* which is related to what an engineer *does*. The major engineering functions are: research, development, design, construction, production, industrial, operation (and maintenance), application (and sales), and management.

Research

The research engineer is seeking new knowledge or a better understanding of known facts. He is seeking new principles, new methods, new processes, new truths. He is working on the frontier of scientific knowledge and his training must provide a thorough understanding of advanced mathematical and scientific concepts. He must have the ability to reason inductively and in abstract terms, and to express himself in new mathematical forms. He should be skilled in analysis.

Development

The job of the development engineer is to apply the discoveries and results of re-

search to some useful purpose. He uses the principles, tools and techniques made available through research. His efforts usually result in a working model of a circuit or process or machine which has desirable characteristics. The development engineer must be ingenious and creative. He should be skilled in experimentation. He must have great initiative and perseverance.

Design

The design engineer takes the result of the development engineer and carries it to the point where it is economically useful. He designs products so that they can be manufactured and sold at a profit. His work consists of: selecting methods of accomplishing desired results; investigating processes and devices to perform intended functions; selecting materials and determining shapes to satisfy physical, chemical, electrical and thermal requirements. The design engineer must have advanced training in the properties and behavior of materials and processes and the ability to adapt recent advances to current practice. He must be skilled in synthesis. He must be proficient in graphical expression and have a strong background in economy.

Construction

The construction engineer is responsible for surveying the site and preparing the location for the structure. He determines the procedures to be followed on the basis of economy and desired quality of the result. He directs the assembly, placing and joining of materials. He organizes the personnel to carry out these operations. The construction engineer must be skilled in the art of his profession. He must be able to direct people effectively and have a firm grasp of costs.

Production

The work of the production engineer closely parallels the construction function except that it is concerned primarily with products constructed in a factory or other fixed location to be operated elsewhere. He chooses the processes of manufacture, the sequences, the tools, and the methods. He integrates the flow of materials and components with processes. He provides inspection and testing facilities and procedures. He eliminates bottlenecks and corrects faults in manufacturing procedures. He works closely with designers through early stages of production and participates in redesign.

Industrial

The industrial engineer works closely with the Production Engineer and frequently there is some overlapping. He works with the Production Engineer in selecting equipment and laying out the plant, in so far as human and economic factors are concerned. He devises jigs and fixtures and work stations which facilitate human effort and increase production. He writes job descriptions and makes job evaluations. He makes time studies, sets standards and rates of pay and designs incentive pay systems. He operates cost controls, supervises clerical procedures and forecasts production costs under new conditions. The industrial engineer is primarily concerned with the economic and human factors in production and his training and personal qualifications must be suitable.

Operation and Maintenance

The operating engineer controls machines, plants or organizations which provide services such as power, utilities, transportation, communication or storage. He is responsible for the selection, installation and maintenance of equipment. As the supervisor of an over-all manufacturing operation he is sometimes called the plant engineer. He is responsible for preventive maintenance programs and the operation of complex equipment for maximum economy. He determines operating procedures and supervises operating personnel.

Application and Sales

The application engineer analyzes customers' requirements and selects and rec-

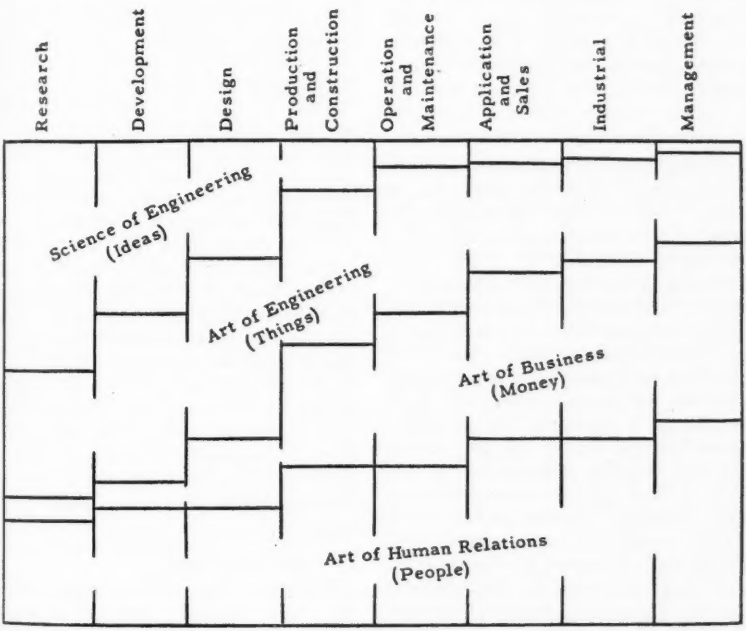
ommends units to satisfy their specifications most economically. He combines salesmanship with technical education and training in application. He analyzes customers' complaints and trains the customers' operating personnel. He must be able to deal with persons at all technical levels from the maintenance man to the research scientist. The application engineer must be skilled in verbal expression and have a strong business training.

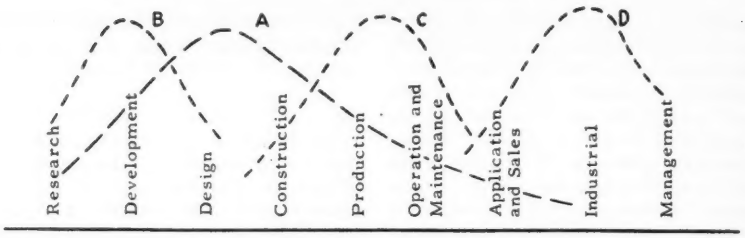
Management

It is the responsibility of management to determine the main purposes of an enterprise and to set up the policies to be followed. The manager sets up the form of organization, the chain of authority and selects the executive personnel. Engineers have proven valuable in management positions because of their ability in analyzing the factors involved in a problem, collecting the necessary data and drawing sound conclusions. The primary requirements include a background of engineering fundamentals, skill in human relations and ability in business.

Engineering Activities

The foregoing detailed discussion is included here because the functional classification is more meaningful to a student attempting to plan a career in engineering. The basic requirements for engineering are aptitude, training and interest. Interest is usually associated with *field* of engineering, while aptitude and training are more closely associated with *function*. The requirements for work in the production, say, of electric motors, are almost exactly the same as those for the production of internal combustion engines. The design of a bridge requires nearly the same training as does the design of an airplane fuselage. The operation of a refinery involves the same problems as the operation of a steam power generating plant.





In general, engineers work with "ideas" (abstract scientific concepts and principles), "things" (machines, materials, structures, circuits), "people" (supervisory and personal relations) and "money" (costs, investments, profit, interest). The extent to which engineers in various positions employ knowledge in the four areas is indicated roughly in the chart below. If this approach is valid, then there is a second reason why the functional classification is desirable from the standpoint of training. Early in his college training the student should be able to decide whether he prefers to work with ideas, or machines and equipment, or men, or money. On the basis of such a decision, it is relatively easy to counsel a student into the proper training.

The Engineering Spectrum

Assuming that the functional classification is desirable from the standpoint of training, we have a basis for reducing the number of objectives per student. The above chart illustrates the spectrum of engineering activities, each requiring a different combination of aptitudes and personal qualifications. Curve A indicates the approach of many "standard" engineering programs with emphasis on design but with a wide range of objectives. Curve B represents the specialized program carried on by certain schools which are building reputations on the quality of their graduates in creative activities. Curve C indicates an area which is being vacated as some schools shift emphasis from A toward B. Curve D includes programs preparing for positions which are of great importance to industry but which frequently go unaccredited because of their lack of "design emphasis." There are, of course, no sharp lines of demarcation between these activities. Since these are but subdivisions of engineering, in all programs there will be a common core of scientific fundamentals, technology, basic skills and humanistic-social studies. However, programs preparing for different areas of the spectrum should have certain distinguishing characteristics in their faculty, equipment, student selection and course objectives.

Distinguishing Characteristics

A school of Type B must choose for its faculty men of ability in research and development, creative men who are anxious to contribute to the advance of knowledge through carrying on research programs and publishing scientific papers. On the other hand, in Type C there should be greater emphasis upon experience in the practice of engineering. Equipment selected for a program of Type C would provide opportunity for study of the over-all characteristics of complex units, whereas students following a program of Type B would be more interested in engineering fundamentals as demonstrated by research type apparatus. Perhaps students enrolled in a Type D program should be extroverts with ability to work with people and interest in economic aspects of engineering problems. All too often the industrial engineer is one who just barely got through a Type A program.

Student Counselling

For a long time we have been encouraging, if not requiring, students to special-

ize by field. We have worked hard at determining whether students were qualified for engineering training on the assumption that engineering is a single activity rather than a broad spectrum of activities. It is not to be expected that one type of training would be best for all functions, nor that one type of individual would be equally suited to all functions, nor that one type of training would be best for all individuals. There must be more attention paid to evaluating students' abilities along the lines previously indicated. Probably the first two years of engineering programs should continue to be pretty well standardized. During that time there should be opportunity for a student and his counsellor to decide on a desirable functional specialization.

Responsibility of the Schools

Each school must determine what its role in engineering education is to be. Obviously there will be considerable overlapping. However, each school should have its objectives clearly in mind instead of trying to be all things to all people. Certain schools will find it desirable to offer more than one program in a given field. For example, one western university now offers programs in construction engineering, civil engineering (design) and engineering mechanics (research). These programs deal to a large extent with the same subject matter, engineering structures. However, there is a clear differentiation between faculty, courses and students. Another school might decide that in terms of its faculty, facilities and location, a combination of a Type B program in electrical engineering and a Type D program in mechanical engineering is desirable, say.

It will be necessary to reorganize some course offerings. For example, in the past it has been customary to offer "thermodynamics for electrical engineers." Obviously the electrical engineer doing design needs exactly the same training in heat transfer as does the mechanical engineer doing design. What we need are courses in "thermodynamics for design engineers" and "thermodynamics for operating engineers." We need "electrical engineering for research" and frequently this is available—in the physics department. The important thing is that there must be a more critical approach to organization of programs, curricula and courses.

Conclusion

In engineering education we face the difficult task of preparing our graduates for a field which has progressed rapidly and promises to continue that progress at an ever-accelerating rate. In my opinion, the best approach to our common problem is to reduce the number of objectives per student.

This can be accomplished by recognizing that engineering is a broad spectrum of activities and by employing the functional classification of engineering as a basis for organization of engineering programs. Each school must determine just what its contribution in engineering education is to be. Each school must set down clearly the functional objectives of its various programs. Faculty, courses, facilities and student counselling procedures must reflect the chosen objectives. It will be a difficult job but it offers one means whereby engineering education can keep pace with engineering technology.

Young Engineering Teachers' Paper Contest

RULES

Eligibility: Members of ASEE who are not over 35 years of age (their 36th birthday must not be before June 1, 1954).

Awards: First prize $200—Second prize $100.
Honorable mentions as determined by the Judging Committee.

Presentation of Awards: The awards are known as the "President's Awards." They will be presented to the recipients by the President of the Society at the Annual Banquet at the University of Illinois, June 17, 1954.

Subject: Papers should deal with some constructive phase of improvement of engineering education. Participants are encouraged to use their own judgment in selecting appropriate subject matter.
The following are suggestions of possible subjects:

1. Professional development of the Young Engineering Teacher.
2. How should the student be helped to learn to deal with situations that are new to him, on his own initiative and with well-ordered professional thinking?
3. To what extent should modern physics be included in the engineering curriculum and how should this be done?
4. What areas of physics, chemistry, mathematics and biology not now taught in engineering curricula are likely to be translated into significant engineering practice in the next 25 years and how should this influence present curricula?
5. To what extent and in what manner should undergraduate instruction acquaint the engineering student with the methods of research and with recent research developments in engineering and closely allied sciences.
6. What should be taught of the art of engineering as contrasted with its science?
7. What basic science, mathematics and communication principles and skills can best be taught by separate department staffs and what part by integration into engineering courses?
8. What can be done in college to prepare the young engineer to continue to learn after his formal education is ended?
9. How should non-major courses in engineering such as electrical engineering for non-electricals be planned as to content and method?

Length of Paper: Not to exceed 2500 words.

Submission of Entries: All entries should be submitted to the Chairman of the ASEE Section in which the member resides before March 1, 1954. Names and school affiliations of Section Chairmen are published each month on the page in the Journal of Engineering Education designated "Section Meetings." Papers submitted in the contest last year or in other contests are not eligible for this year's contest.

Judging: Each Section of ASEE will appoint a Judging Committee to select the best paper from the Section. This paper will be submitted to the ASEE Secretary before April 1, 1954.

The winning papers from the various ASEE Sections will be submitted to a Final Judging Committee for the final selection.

Here is an opportunity to gain national distinction. Good luck!

Engineering Education and Engineer-in-Training Examinations

The following papers were presented at the ECAC General Session on June 25, 1953 at the University of Florida, Gainesville, Florida.

1. Dean J. H. Lampe, North Carolina State College, Introduction and Outline for the Problem.
2. Professor C. S. Crouse, University of Kentucky, One Viewpoint of This Problem.
3. Dean Roy M. Green, University of Nebraska, Another Viewpoint of This Problem.

Opening Statement by Dean J. H. Lampe, North Carolina State College, Introducing the Discussion

Professional recognition is the abstract goal sought by the engineering profession and by practically every man who has reached the level where others tender to him the title Professional Engineer. This recognition may well be called our most persistent yearning—a yearning of long standing.

There were probably two principal reasons for the creation of Engineers Council for Professional Development twenty-one years ago. First, there was a deep concern because of the large number of young men entering the initial educational programs and a relatively few developing into real engineers. Second, there was a deep-seated yearning on the part of engineers that other well-informed men recognize us as truly professional men.

To study these matters systematically and to suggest actions to improve the situation, ECPD promptly set up four principal committees or divisions: (1) Student Selection and Guidance, (2) Engineering Schools, (3) Professional Training, and (4) Professional Recognition.

For convenience these four specific committees were neatly titled and identified, but the problems these committees studied were inter-related. It may therefore be said that every engineer, no matter what his position may be, has a real interest and a real stake in the deliberations and actions of each and all of the four committees.

Throughout its life ECPD has had as two of its participating bodies the National Council of State Boards of Engineering Examiners and the American Society for Engineering Education. Throughout the history of these two groups there has been an interlocking of interests and a sharing of problems. Both have been equally concerned with the goal of professional recognition.

The intimacy of their relationship is well illustrated by the wording of the Model Law for the registration of professional engineers. The definition of a professional engineer is one "who, by reason of his special knowledge of the mathematical and physical sciences and the principles and methods of engineering analysis and design, acquired by professional education and practical experience, is qualified to practice engineering." As minimum evidence of qualifications for registration the law further provides "graduation in an approved engineering curriculum of four years or more from a

school or college approved by the Board as of satisfactory standing; and a specific record of an additional four years or more of experience in engineering work of a character satisfactory to the Board, *and indicating that the applicant is competent to practice engineering.*" Provisions to this general effect are in practically all state laws, although there is an occasional variation in the years of required experience.

At a conference in 1943 representatives of ten national engineering organizations approved several amendments of the Model Law as perfected in 1937. In the last edition of the Model Law (1946, page 6) is the following statement, "All amendments were adopted unanimously, the most significant being the insertion of provisions whereby the examination for professional engineers may be taken in two parts—the first at the time of graduation in an approved engineering curriculum, or upon evidence of attainment of the equivalent, with respect to fundamental engineering subjects, at which time those successfully passing this portion of the professional examination may be provided with certificates designating them as engineers-in-training, to whom it is expected that after four years of active practice the second part of the examination will be given, the successful passing of which will permit them to become professional engineers."

Either the propriety or the efficency of the engineer-in-training examination as a registration procedure to be applied to graduates of "approved" schools has often been questioned. The practice of giving such examinations has grown very rapidly since 1943. If the giving of such examinations is unsound practice, a movement should be initiated to reverse the trend. If the practice is wise and justifiable, it should be promptly expanded to every state in the United States. Our program today is intended to bring this question before the Society for discussion.

In order that the discussion may be focused only upon the question, the speakers have agreed to the following three statements.

1. The sole purpose of registration laws is to "safeguard life, health, and property and to promote the public welfare."

2. Examining boards have no legal or moral right to expand their activity beyond the administration of the laws as written and within the geographical boundaries of their legal jurisdiction.

3. It is the duty of each board to register all applicants who are competent to practice professional engineering and to refuse registration to those who are incompetent. The time at which such competence must be determined by the board is the time at which a certificate is issued to practice professional engineering.

One Viewpoint of This Problem

By C. S. CROUSE

Professor and Head, Mining and Metallurgical Engineering, University of Kentucky

I have been asked to talk about the Engineer-in-Training program and the relationship of this program to engineering education. As a matter of fact this constitutes but one phase of the Registration movement which includes the effect of professional licensing on engineering curricula also. It therefore seems advisable to take a general look at the picture and to present some historical background before discussing the particular as set out in the agenda.

State licensing of any sort and this includes that of Professional Engineers is based legally on one thing and one thing only, the police powers of the State.

This must never be lost sight of as all phases of the laws involved, all rules and regulations that Licensing Boards may set up are null and void unless they can be definitely tied in, in a logical way, to these police powers, in other words to the health and safety of the public.

This statement undoubtedly entails a definition or an interpretation of what can logically and legally affect the health and safety of the public. In the last analysis this will have to be determined by court decisions which quite likely will vary somewhat through the different states. But until such data is obtained, and it is not available in any amount as yet, the individual State Boards are having to make their own interpretations and distinctions.

Two Schools of Thought

In this regard there seems to be two distinct schools of thought; a very literal interpretation and one that is perhaps somewhat more liberal but still within the framework of the law. In the first case it might be held that only those who are involved in engineering work that can be shown to very directly affect the public would need to be licensed. In the more general and to my mind the more logical interpretation, anything that an engineer may do professionally somewhere and in some way touches upon the health and safety of the public. My remarks will be predicated upon this concept.

At the present time there are engineering licensing laws in effect in all of the 48 states, in the three Territories of Hawaii, Alaska, and Puerto Rico, and in the District of Columbia. These laws are administered by legally appointed Boards and each one is entirely autonomous in its actions and must of course act within the framework of the particular state law involved.

However, most of the laws, in addition to the savings provision or so-called Grandfather's Clause, embody or have embodied two main ways in which licensing might be obtained. One of these is that registration may be given to a candidate who can show graduation from an accredited engineering curriculum and a minimum period of years, usually four, of qualifying experience satisfactory to the Board. In the other case the candidate must show a minimum of usually eight years of satisfactory qualifying experience, five of which might be while obtaining his education, and successfully pass a written or a written and oral examination.

As time went on many states, for one reason or another, amended their laws so as to eliminate registration through graduation and experience only thus requiring the successful passage of a written or written and oral examination in practically all cases before licensing would be allowed. This situation exists in about fifty per cent of the States today.

This trend has had a definite effect on engineering education entailing as it does a reconciling of view point, where necessary, between the engineer who is teaching and the engineer in the field. I think that the implications are self evident but not too directly concerned with the Engineer-in-Training program.

Manifestly, although the only legal justification for licensing pertains to the health and safety of the public, nevertheless there are certain corollary effects which have had their effect on the Profession. Among these has been the undoubted better understanding of and respect for the Profession by the public as a whole, a better understanding of what engineering is and of what engineers are, both within and without the profession, in brief, the attainment of a truly professional status. In addition, and quite possibly even more important, there has been inculcated into the engineers themselves a better understanding of the intangibles of professional ethics and a true professional consciousness.

As the Registration movement grew it became incumbent upon the various State Boards to determine which curricula and which engineering colleges would be considered as having accreditation status with

that Board. I deem it self evident that the necessary investigation prior to such accreditation by the individual State Boards of all of the engineering curricula in the United States posed a monumental problem and if carried on on that basis would lead to inequities due to varying criteria.

No Other Alternative

However, lacking any other procedure, the various State Boards were left with no other alternative than to attempt the practically impossible, New York doing an excellent piece of work in this respect.

As more and more of the States passed licensing laws this procedure became more complex and more onerous and costly both to the Boards and to the schools involved and lead inevitably to the conclusion that what was needed was an engineering agency to investigate and accredit engineering curricula. As a result Engineer's Council for Professional Development was formed with one of its major objectives the development of a fair and impartial method for the evaluation of the minimum requirements of an engineering curriculum which would make that curriculum subject to accreditation. The constituent bodies of E.C.P.D. were and still are: the four Founder Societies, the American Institute of Chemical Engineers, the Engineering Institute of Canada, the National Council of State Boards of Engineering Examiners, and our own Society.

E.C.P.D. divided the country into zones, the constituent Societies appointed engineers from among whom the actual accreditation committees could be chosen and the work got under way. This was to all intents and purposes the first time that an attempt, on this scale at least, had been made to view engineering education nationally with a somewhat uniform set of minimum standards. In some institutions the result of the procedure was scarcely felt; in others it caused a re-evaluation of objectives and in others the impact was terrific.

It can be readily seen, then, that legal licensing with its demand for accreditation which resulted in the founding or formation of E.C.P.D. and its accreditation program has had, and, I believe, will continue to have a far reaching effect on engineering education.

Again with the passage of time a new element entered the picture. The developments in the fundamental sciences of Physics and Chemistry to name but two were and are rapid and drastic. When developed into engineering techniques, these, in many instances caused the introduction of undergraduate curricula of considerable specialization. This proliferation of so-called "fringe curricula" and the pressure from the schools put upon the Education Committee of E.C.P.D. for their inspection and probable accreditation presented a problem which is not yet wholly solved. To further complicate an already complicated situation various of the State Registration Boards began to look askance at some of the curricula accredited by E.C.P.D. as not being of sufficient caliber to properly train an engineer at least according to the definitions of these Boards. This in turn presented a serious threat to the whole accreditation procedure with the ultimate result, if the trend continued, of throwing the procedure back into the near chaos of individual Board accreditation.

This problem has definitely worked back into the Colleges; in fact they have in no small degree been responsible for its creation, and its effect upon engineering education has certainly already been felt and in my opinion will be felt even more in the future.

During the same time that proliferation of engineering curricula was taking place the developments in the fundamental sciences already spoken of were happening even more rapidly. This made it quite apparent that, if the engineer were to be properly trained in his profession, the basic science foundation of an engineering curriculum must be increased with a consequent use of more

time in a fixed time curriculum for fundamentals and consequently less time for specialization. Certainly these two trends were antithetical.

The Executive Committee of E.C.P.D. had discussed this situation at a number of meetings and finally appointed a Committee on the Adequacy and Standards of Engineering Education with Past President Hollister as Chairman. There were three other members of this committee of which I was one but Dean Hollister did the work. The report of this committee was rather widely publicized and I believe has had and will have some effect.

After the publication of this report, E.C.P.D. felt that the work should be continued with a broader scope and asked our Society to take over, the result being the formation of Dean Grinter's committee on the Evaluation of Engineering Education. This committee went right to work and is reporting at this meeting.

In what I have said so far I may appear to have wandered from my assigned subject but, if I have, it has been with purpose, as I do not believe that persons more or less unfamiliar with what has been going on specifically in the very interrelated and rather complexly intertwined developments coming from the Registration Boards, the E.C.P.D., the Engineering Colleges and from our own Society, can grasp the true significance of the problem without the overall picture.

The so called Engineer-in-Training program, and it is quite possible that a better name could be found for it, is only comparatively a few years old. In many States it is quite a lusty child; in others it is aborning and in others it is not yet conceived.

What is the program; why was it developed; and how does it justify its existence both legally and otherwise as well; and how has it or may it affect engineering education are all questions of importance and ones that I will attempt to answer briefly against the backdrop already painted.

Graduation Does Not Make an Engineer

I think everyone will acknowledge that the mere graduation from an engineering curriculum does not make an engineer. Adequate experience in some phase of engineering practice is fully as important as the acquisition of technical knowledge. In most States, if not in all, an engineering graduate cannot legally be considered for license until he has secured a minimum of four years of qualifying experience satisfactory to the Board and often it takes a considerably longer experience time record than the minimum. Briefly the Board must be satisfied and the time record cannot be less than the minimum but it can be and often is greater.

This means, then, that under the most favorable conditions there is a hiatus of four years between graduation and legal recognition. This gap has been recognized for years by the Founder Societies in their qualifications for full membership.

In the past and unfortunately in many instances today the engineering colleges have had a tendency to turn their graduates loose, except for some aid in finding the initial position, and left them to sink or swim with little or no guidance in this critical period of their careers. At the same time two of the things that might help the man in this phase of his development, a true professional consciousness and a thorough concept of professional ethics, may be lacking as most undergraduate curricula do not stress these, to my mind, essential subjects in an engineer's training.

With legal licensing being a prerequisite to professional practice anywhere in the United States, one of the first and most important objectives of the young graduate is to qualify for registration as soon as possible. This means in turn that he must secure the proper kind of qualifying experience and, when that is acquired, must, in most States, pass a written examination.

These examinations are, on the average, of two days' duration, the first day being designed to ascertain the candidate's

knowledge of what is usually given in an undergraduate engineering curriculum with the emphasis on fundamentals and the second day attempting to determine what he has been taught by his experience. A man upon graduation could not hope to pass the second-day examination because he would not have had the experience background, and it is becoming increasingly difficult for the man with experience alone to pass the first part because he has not had the necessary formal education.

The problem of the young engineer in the interim between graduation and the attainment of professional recognition is two-fold. First he should be integrated into the profession as rapidly as possible, and secondly, and this is probably a part of the first problem, he should be guided in such a manner as to acquire the minimum qualifications for licensing as early as is legally possible.

It has been said by some that the Engineer-in-Training Program cannot be legally justified on the basis of the police powers of the State. I take exception to this viewpoint as a too narrow interpretation of the facts. I hold that anything that tends to make a man a more competent engineer directly affects or in time will affect the health and safety of the public. This is true not only during the young man's training prior to licensing but more particularly is it applicable after he has obtained registration and the legal status of a professional engineer. In my opinion the Engineer-in-Training Program has this effect.

Recognizing the situation outlined and feeling strongly that something should be done about it, several of the State Boards a number of years ago established what they called the Engineer-in-Training Program. The objectives of this program were to earmark, as it were, the young graduate for the engineering profession by in some way publicly labelling him as one working toward professional status. At the same time it was expected that this would help the individual's own morale and develop his professional integrity and competence more rapidly.

It is evident that the State Boards, as such, could do little to actually aid the man in his apprentice period but they definitely could label him so that the professional engineers with whom he might come into contact could take over.

The next question was as to how to apply this label and the solution worked out was to offer, and I want to emphasize that word offer, the young man about to graduate or immediately after graduation the opportunity to take an examination designed to show his competency in the fundamentals of an engineering education. If the man passed this examination he was then to be given a certificate stating that he had passed such an examination and that he was qualified as an Engineer-in-Training by the particular State Board involved. Please note that nowhere in the procedure is there any compulsion and that the certificate issued has no legal significance whatever.

The idea of the program and the procedures worked out to implement it took hold rather rapidly so that at this time many of the State Boards have inaugurated the program and others are considering it. In some States the program was authorized by legislative amendment to the existing law; in others through regulations of the Board.

Details Vary

The details of the plan vary somewhat as between States, which is to be expected, but in general the Engineer-in-Training examination is a written one of eight hours' duration based on the fundamentals usually taught in a four-year engineering curriculum. The cost of taking the examination varies from about three to five dollars with, in some cases, this fee being credited to the subsequent examination for licensing. As the program developed, so also did the feeling that some procedure should be worked out whereby a man might receive credit for his Engineer-in-Training status as be-

tween States. The result has been that most of the States now recognize the Engineer-in-Training examination of the other States and will give credit for it up to eight hours on the examination for professional licensing. In other words if a man has passed an Engineer-in-Training examination in one State he will be given credit for one day of the professional examination by most of the other States that have the program.

That the efforts of the State Boards along this line have the hearty support of the young engineering graduate is evidenced by the increase in numbers taking the examination. When a young man about to graduate or recently graduated from an engineering curriculum is not only willing but anxious to pay from three to five dollars for the privilege of working hard for eight hours, he must feel that what he receives, if the passes, is well worth the effort.

What has been the overall effect of the development of this program? It may be divided into two parts; the effect upon the individual and upon the profession and the production of better qualified engineers; and the effect upon engineering education. The first effect has proved to be rather definite already; the second more nebulous becoming increasingly more definitive as shown by the interest at this meeting.

I have said that the licensing Boards as such could do little more than attempt to label a man for the profession, the full effect both individually and professionally resting upon the interest and work of other agencies. These agencies, many of them, have taken up the challenge and are doing yeoman work.

E.C.P.D. was among the first to tackle the job and the work of the Monteith Committee resulting in the Monteith report was outstanding. However, the scope of the procedure as outlined in the report was such that it could not be implemented immediately. Neither the necessary funds nor the personnel were available. However, a great deal of extremely constructive work has been and is being done along the lines laid down in the report, and this not only through the efforts of E.C.P.D. alone but also with the cooperation of many other agencies and of Industry.

The results on the individual have been many not the least of which has been the easing of his integration into the social, civic and professional life of the community through the thoughtful interest taken in him by outside agencies and individuals. At the same time there has been a very definite and tangible effect as shown by the fact that, in many instances, governmental agencies and industry as well are definitely paying higher salaries for exactly the same work to those holding certificates as Engineers in Training than to those who do not hold such a certificate.

The effect on engineering education is evidenced in two directions; on the graduate program and on the undergraduate program.

In the former case it applies largely to those schools located in industrial centers which can offer night courses in advanced phases of engineering. Here the effort being made is to make it easy for the young graduate to continue his formal education while he at the same time is making his living. Both Industry and the Colleges in these areas are cooperating to further this objective. More can be done in this field in the way of offering well worked out extension courses either with or without College credit and through the arranging of periodic lectures and conferences given by outstanding men in various fields. This phase of the program for the up-grading of the young engineering graduate is already being emphasized in various areas, the work along this line being done in Canada being especially noteworthy.

Impact

The impact of the Engineer-in-Training Program on the undergraduate curriculum has not yet been felt to any great extent with the possible exception of a

few locations in which the program has been in existence for a considerable period of time. This is due, I think, to a number of reasons, not the least of which is the opinion of some Deans and engineering teachers that there is not and cannot be any connection between the two. In these cases the curriculum and teaching seem to be sacrosanct and any failure on the part of the young graduate to pass his Engineer-in-Training examination is due to the examination itself and not to the man's scholastic background.

I would be the last to claim that any examination is perfect; I have been teaching too long for that, and I feel strongly that written examinations are but one of a number of criteria that should be used to judge of a man's qualifications. Nevertheless, I firmly believe that when an examination such as that for an Engineer-in-Training has been well considered, has stood the test of repetition, and when students from some schools average good grades and these from others not so good, then it must mean something in so far as the undergraduate preparation of the individual taking the examination is concerned. Again, when students in a given institution average consistently good grades in some areas and consistently poor ones in others, I would consider it only the part of wisdom to inquire into preparation, method of teaching and course content in those fields in which student preparation seems to be the poorest.

No one should take an ostrich-like attitude and bury his head in the sand because sooner or later it will cause a rude awakening. Rather, I am sure, the truly constructive attitude is to examine the results of these examinations over a long enough period of time so that it may be done statistically and then, if any definite trends are shown, try to remedy any faults that may be found. This is especially true as between different Colleges the graduates of which are taking the same examination and as between different Department within a given College where definite weakness may appear.

In some States where the program has been under way for a considerable period, study has shown that the graduates from certain of the institutions in those States do far better than those from other institutions and those that do better do not necessarily come from the more widely known schools. If such information could be made available, it should prove of great benefit to the administrative officers of the schools involved. No individual or school is so perfect that improvement cannot be made.

I have personally made some rough statistical appraisals of the results in my own State and I have no hesitancy in saying that some trends have been found. What they may mean is quite another question but I firmly believe that if an honest conscientious effort to find the answer or answers is made and, if the answer appears to be unfavorable and then the same sort of effort is made to correct the situation, the impact of the Engineer-in-Training program upon undergraduate curricula and instruction may be very great indeed. If we have a yard stick, even an imperfect one, by which we can in part measure the effect of what we are trying to do, we should by all means use it even though the results may prove embarrassing. If we can find the trouble, we should be able to correct it.

It is hard to conceive of a man with four years of training getting a flat zero in the physics section or the mathematics section of an examination while the most of those taking the same examination have passed these sections creditably. Yet this has happened not once but a number of times. Should such a man be graduated with a Bachelor's degree in Engineering? Personally I doubt it. And yet this individual is probably more sinned against than sinning. Somewhere down the line someone has slipped up because such a man should never have been allowed to reach the Senior year, let alone graduate.

Yes, in my opinion, there is a very definite interrelation between the Engineer-in-Training program and engineering education. It is definitely incumbent

upon those of us engineers who are employed in the teaching branch of the profession to use any means at hand to improve our theory and practice, and I feel sure that a careful, intelligent study of the results of Engineers-in-Training examinations is one of these means. If this is done constructively and impartially, letting the chips fall where they may, I cannot help but feel that great good will result therefrom.

Parenthetically it should be stated that so far as the mechanics of the operation are concerned most of the State Boards are working rather closely with the faculties of the engineering colleges within their respective States in the preparation, administration, and evaluation of the Engineer-in-Training Examinations.

In what I have said I have tried to logically show how and why the Engineer-in-Training program was developed; the beneficial effect that it has had and is having upon the individual, the profession and the public; and the effect that it has had and, I believe, will increasingly have on engineering education.

Controversial Subject

It is unquestionably a controversial subject upon which I have expressed my own views only. What I have said I firmly believe. If I have been able to give you, however briefly, some background information on the subject so that you may more reasonably and logically arrive at your own conclusions, I will consider that the time and effort put into the preparation of this talk to have been well spent and that the objectives that I have had in mind while writing it will have been accomplished.

We are all working toward the same end, the production of a better product. Anything that will tend to promote this is well worth investigating. We cannot expect unanimity of opinion, nor would such be desirable. I feel that anything that will promote honest discussion and intelligent thought will constitute a forward step in the attainment of our objective. I sincerely hope that our program this morning will do just that thing.

Another Viewpoint of This Problem

By ROY M. GREEN

Dean, College of Engineering and Architecture, University of Nebraska

Organizations such as the American Society for Engineering Education are brought into being and continue to exist because their members feel a professional responsibility. Through such organizations the hope is held by the members that they may meet these responsibilities more adequately. Most of the members of our Society have an individual responsibility both as professional engineers and as professional educators. Our members are anxious to discharge their professional obligations.

For clear thinking we should consider in specific and complete terms exactly what we mean by a profession—what we mean by the engineering profession.

A profession is worthy of that designation only when it fulfills the following four conditions:

First, it must have a mission, a goal, an ideal for which it strives. The goal of the engineering profession is that of creating better and more plentiful facilities for the use and convenience of mankind.

Second, it must perpetually strive to extend the body of knowledge which is its particular responsibility and upon which its professional practice is based.

Those who practice a profession are special guardians of the area of knowledge involved in their work. As the profession grows stronger, this knowledge should become more exact and cover more thoroughly the matters involved. Therefore, a significant number of men in the group should be productive research workers. They should question the validity of every assumption made in practice and every method of engineering analysis.

Third, if there is a profession, its members must share their knowledge with each other. Advances made by one person or group should be made available to all other persons who may be able to use them in a professional way. It is by this sharing of knowledge that ideas are tested for validity and practicality. After being tested, these ideas are then ready to be added to the available resources the profession has to offer in advancing its mission.

Fourth, no profession actually exists unless mankind in general is permitted to enjoy the benefits of the special knowledge possessed and used by the practitioners. The abundance of facilities available to the average citizen in the United States attests to the fact that engineers have shared the rewards of their special knowledge. The engineer not only turns the forces of nature to the benefit of mankind, but he does it economically and thereby produces an abundance in many areas where scarcity previously existed.

Function of Registration

By emphasizing these four steps, engineering has become a strong and respected profession. Out stature as a profession is established through our dedication to these four principles. Registration or non-registration has absolutely no influence on our stature as a profession and but very little effect upon our true status among well-informed men. What, then, is the function of registration? Why is it important?

The sole purpose of a registration law is to "safeguard life, health, and property and to promote the public welfare" and this is the declared objective as stated in some form or other in all our registration laws. A board which uses the statute for any other purpose violates the law. A board member is not appointed to represent his profession, but is rather a *professional representative* of the public. An examining board is authorized and appointed in the public interest to "regulate the practice of engineering."

It is the board's duty to register all applicants who are competent to practice professional engineering and to refuse registration to those who are incompetent. The time at which competence *must be determined by the board is the time at which the certificate is issued or denied.* The evidence collected by an examining board must be conclusive on the date of such issuance or denial. Evidence collected by giving engineer-in-training examinations at graduation time, if justifiable, must be part of this conclusive evidence three or four years later, for most laws require from three to four years' experience following graduation before a certificate to practice may be issued. Our only questions at issue then are these: Does the EIT examination provide a necessary part of conclusive evidence of competence at the time of registration? Do EIT examinations furnish the best evidence of an adequate educational background? Is requiring an EIT examination a wise and considerate treatment of the young men we expect to develop into professional men?

Proponents of the EIT examination argue that the test should be given at the time of graduation because the applicant can pass it more readily at that time. (Report of 1949 NCSBEE, page 108). I know of no one who will deny this is the time examinations, such as are now given, are most readily passed. If this be true, however, the board is gathering irrelevant information upon which to decide whether to issue or deny a certificate four years later, because the graduate will forget just as many of the details of his

technical knowledge whether he did or did not take such an examination at the time of graduation.

The proceedings of the twenty-sixth annual meeting of the National Council of State Boards of Engineering Examiners held in New York City in 1947 contains a report of the Committee on Engineers-in-Training. In that report is the following statement: "The majority of the Committee feels that written examinations should be required of all candidates before certification as Engineers-in-Training for the following reasons:

"(1) There is a wide difference in the technical ability of graduates. The minimum requirements for graduation and for certification as an Engineer-in-Training are set by independent organizations and need not necessarily coincide.

"(2) Many graduates have no intention of ever becoming registered professional engineers, or even practicing the profession of engineering. They intend to be technically trained businessmen, or go into administrative work.

"(3) It will cheapen the registration movement in the eyes of the young engineer, to give him status as an Engineer-in-Training without any effort on his part."

The reasons given for EIT examinations as listed above are interesting. We would all agree that the abilities of graduates vary, and that the standards for graduation and for certification as Engineers-in-Training need not be the same. I find no justification, however, for a different standard unless there is evidence that the EIT standard indicates competence to practice professional engineering four years later.

We would agree that some graduates do not intend to practice engineering. It is difficult for me to see any connection with this statement and the question of giving EIT examinations. If the statement is an inference that planning for other than a professional engineering career shows inferiority on the part of any young man, it is high time that someone requests proof of such an inference.

The third reason given in the report seems strange. That is that "It will cheapen the registration movement in the eyes of the young engineer, to give him status as an Engineer-in-Training without any effort on his part."

Artificial Barrier

Is it assumed that the young engineer made no effort in earning his degree? If the standing of the registration movement "in the eyes of the young engineer" is dependent upon clearing an artificial barrier created by older members of the profession, the whole movement will, and should, fall of its own dead weight. Do we create a lasting respect by demanding artificial sacrifice of time that could be used more beneficially in developing better men? In many states engineering societies are conducting coaching schools to encourage and aid young graduates in reviewing their college work. The sole purpose of this effort is directed toward passing these examinations. We then have the queer situation where one segment of the profession is designing an artificial barrier for entrance to practice, and another group showing how to get over it. It would appear that a much more beneficial professional service could be performed if these assisting groups would help in the process of professional development in a realistic sense by encouraging the graduates to be more effective practicing engineers along the lines of the four professional criteria mentioned in earlier parts of this discussion.

At the same meeting in 1947 (page 69 of the *Proceedings*), Dean W. N. Dougherty, among other things, had this to say, "I debate seriously as a member of an examining board that has been writing questions for 26 years whether or not that series of examinations can be validated at all with the performance of engineers registered within 26 years. We assume our examination is the kind of thing that everybody should take. It hasn't been

validated, what makes us believe as engineers that we can give an examination that will indicate qualification to practice engineering?"

Dean Dougherty's statement was answered most directly by Mr. D. B. Steinman of New York. Part of his answer was given in the *Proceedings* as follows: "Dean Dougherty asks whether we can prove a correlation between the passing of an examination and professional success. That question is not asked by the lawyers or doctors. They have settled that question long ago, and the examination is the *mandatory* entrance requirement into the profession."

Apparently neither the Committee nor the advocates of EIT examinations claim the examination is a test of whether the applicant is competent to practice professional engineering. Is such a procedure right just because the doctors and lawyers use it? Is the practice of law like the practice of medicine? Is the practice of engineering like either? Should the engineering profession attempt to solve its own problems or simply ape some other group?

Some states require the Engineer-in-Training to take another written examination in professional engineering four years after graduation, at which time a certificate to practice is issued if the applicant passes the examination. Other states simply issue a certificate of registration after the young engineer has had four years of experience "satisfactory to the board."

Professional Development

The development of a professional man is dependent upon continuing the learning and study process. A person who may fail the EIT examinations while in school and continues to develop by extending himself as an engineering learner is likely to be a much better engineer four years after graduation than one who passes the examination and then becomes a reluctant participant in the learning process. Hence the EIT examination, in some instances, becomes an artificial barrier without significance in the determination of ability to practice engineering.

Boards should examine each engineer as he is actually practicing his profession and not as he may become by going through a cramming process for six months or six days. Such college-course examinations are not logical tools to use in determining competence for practicing engineering. The design of *strictly professional engineering examinations is extremely difficult.* The development of such a discriminating method of professional appraisal is, however, the responsibility which has been assumed by each examining board.

The definition of a "professional engineer" as given in the last published model law is "a person who, by reason of his special knowledge of the mathematical and physical sciences and the principles and methods of engineering analysis and design acquired by professional education and practical experience, is qualified to practice engineering." Earlier model laws defined a "Professional engineer" as "a person who, by reason of his knowledge of mathematics, the physical sciences and the principles of engineering gained by education and experience, is qualified to engage in engineering practice." Most of our laws contain one or the other of these provisions, thus rightly requiring evidence of some educational background in mathematics, physical science, and principles of engineering. The question, therefore, is, does an eight-hour examination give better evidence of this educational background than the transcript from an accredited engineering school? The transcript represents the composite judgment of many examiners accumulated over a period of four years or more. Further, the transcript is a very detailed report with a subject-field coverage which is more complete than any eight-hour examination could possibly contemplate. To me the transcript constitutes better evidence of an educational background than a single examination.

In 1937 E.C.P.D. began the arduous

task of accrediting curricula leading to engineering degrees. This accreditation program, while not perfectly satisfactory, has been continued with very commendable results. The task of school visitation and inspection was undertaken at the urgent request of the majority of the professional engineering societies and associations, including our own. The organization which was most vigorous in promoting the E.C.P.D. accrediting program was the National Council of State Boards of Engineering Examiners, and the Council has always appointed representatives upon the delegatory inspection groups. It is illogical that this group should continue to advocate and take part in such accreditation programs and then assume that they must retest the product which has already been tested many times in the educational process which they have already approved. It is frankly admitted that some other groups, such as the legal and medical professions, have done the same thing in the past. Previous use of this device by others does not make the process any more logical or justifiable.

In some states the Engineer-in-Training examinations are prepared and graded by the same teachers who have also taught the students and given them their course work and examinations. Are we to assume that such teachers are more intelligent or careful when they perform such work for an examining board than when they conduct their regular work? Are we to assume these teachers know more about the students' background of knowledge by giving a single examination than through a series of class sessions, tests, problem assignments, and final examinations? Are we to assume that only those teachers selected by examining boards are competent to pass upon the students' ability?

The giving of an EIT examination at the time of graduation is, in my opinion, an inconsiderate financial treatment of the young men involved. The various states charge a fee of from $3 to $15 for such examinations. If the examinee moves to another state, he loses the fee and is obliged to pay the full amount when final registration is achieved in another state to which he may move. Since more than half of our college graduates in engineering are in a different state when final registration is achieved, the student simply loses his money. This loss is at a time when young men can least afford to throw away money.

Conclusion

It is respectfully urged that we, as professional men, take steps to alter the trend of giving Engineer-in-Training examinations to graduates from accredited schools. The first step in such a proposal would be for our organization to request that the model law be rewritten, deleting the portion relating to EIT examinations. The second step would be to ask for a joint meeting of representatives of the American Society for Engineering Education and the National Council of State Boards of Engineering Examiners. This joint committee could work toward closer cooperation in the development of a positive method of joint action with a view of preserving the ideal of professional identity for the young graduate during his first few years following graduation.

The Technician and the Engineer *

By C. J. FREUND

Dean, College of Engineering, University of Detroit

The Detroit Edison Company is building a 600,000 kilowatt generating station at St. Clair, Michigan. This is one of two new stations which the company is projecting to supply the constantly expanding needs of Detroit's residents and industries. The St. Clair project is in charge of my good friend Mr. Al Pasini, national vice president of the American Society of Mechanical Engineers.

Very many engineers work directly under Pasini; others cooperate with him. The engineers are associated either with the Detroit Edison Company, or with manufacturers of machinery or equipment, or with contractors doing construction work. They are concerned with the design of buildings, foundations, turbines, generators, boilers, condensers, switchgear and the like. They make decisions on the ground when problems arise which are not covered by prints and specifications.

At the same time, great numbers of technical men on this job are not professional engineers. They are technicians. They direct construction and erecting operations, inspect materials and finished work, and install and test machinery and apparatus. They are the superintendents, foremen, inspectors.

Once the plant is completed, other technicians called stationary engineers will have charge of its daily and regular operation. Professional engineers will stand by, and solve technological problems, design improvements and plan changes.

It is quite true that the functions of engineers and technicians overlap in practice. Engineers in one plant or corporation perform tasks which technicians perform in another plant or corporation. But the theoretical line of demarcation is clear enough.

The engineer understands principles and fundamentals of mathematics, physics and chemistry. He uses his knowledge in research, design and development. The technician likewise knows mathematics, physics and chemistry. But he uses his knowledge to perform calculations, run tests, make estimates and prepare diagrams.

The engineer plans; the technician makes and does. The engineer creates and projects; the technician operates. Of course, there are exceptions. Not all technicians are operators. Many of them assist engineers in creating and planning. They are the draftsmen, estimators, testers, research technologists.

The technician is concerned principally with how to do it. The engineer is concerned principally with why to do it. It is common for the technician to be more competent in the doing than the engineer. For instance, a land surveyor should be handier with a transit than a civil engineer.

In general, the technician is auxiliary to the engineer. This must be clear if the relation of the technician to the engineer is to be understood. Some technical institute people have occasionally been annoyed by mention of this auxiliary status as implying some kind of dishonorable inferiority. In my view, there is no real basis for this feeling and I believe it is disappearing. After all, we have higher anl lower orders throughout our social

* Technical Institute Division, ASEE, University of Florida, June 23, 1953.

and industrial organization. There is nothing dishonorable about being a first class machinist and not a foreman; there is nothing dishonorable about being a superintendent and not a works manager; there is nothing dishonorable about being a salesman and not a sales manager; or a nurse and not a surgeon; or a high school teacher and not the principal; or a sergeant and not a commissioned officer; or a son and not his father and head of the family. There is nothing dishonorable, I hope, about being the dean of a college of engineering and not the president of the university.

If the auxiliary relation of the technician to the engineer is not understood and accepted, there is no chance, in my opinion, for the proper development of technical institutes. Of course, there are in the United States no fixed occupational classifications. Any technician can become an engineer by meeting the well known qualifications.

It seems to me that a most significant feature in the relation of technicians to engineers is simply this: the vast majority of engineers don't understand the function of the technician; and don't realize that technicians, as well as engineers, are in short supply. Indeed, the shortage of technicians is doubtless much more serious than the shortage of engineers, only we don't think and talk about it.

Consider a typical engineer who has a drawing to make, a test to run or some other technician job to do. If a technician is at hand, the engineer gives him the task. If no technician is available, the engineer gives the work to a young engineer, or he does it himself.

The engineer should not do technician work himself. He should spend his time doing his own proper work. You will never catch a surgeon doing nurses' work. It is permissible for a young engineer to perform a certain amount of technician work by way of training and experience. But after he has acquired training and experience, he should not have to perform technician tasks because there are no technicians around. Still more important, he should not spend his whole life doing technician tasks. And too many engineers do just that.

In spite of the serious shortage of technicians, and the fact that too many engineers spend much of their time on technician assignments, I suspect that 90% of engineers never give thought to the education of technicians. I further suspect that 90% don't even know that the technical institute is the proper educational institution for the preparation of technicians.

The engineering profession in the United States ought to be informed about technical institute education. The most effective means of doing this, I should think, is to tell the story directly to engineers. Why should not technical institute men appear in programs of the Founder and other great national engineering societies? Why should not technical institute men publish accounts of their aims and their work in the journals of the engineering profession?

All of us have the habit of telling our story to ourselves. For example, business men meet and tell each other about free enterprise. It would do more good if they told their story before a convention of socialists. In the meeting of the A.S.E.E. at Seattle in 1950, a visitor to the session on cooperative education remarked on the excellence of the program, but said that it should have been presented before the National Association of Manufacturers. Many fine talks before the Technical Institute Division of A.S.E.E. might better have been presented before the American Society of Mechanical Engineers, or the American Society for Metals.

I am today merely a representative of the engineering profession, and I fully realize that I am not as well informed as others concerning technical institutes. However, I feel it would not be out of place for me to recommend that the Technical Institute Division of A.S.E.E. consider whether it should not make the education of us engineers a most important project of the next four or five years.

Reports of the Vice-Presidents

Annual Report of the Engineering College Administrative Council, July 1, 1952-July 1, 1953

Executive Committee Meetings

Four executive committee meetings were scheduled by Chairman Lampe during the year, the first two on September 4 and September 5 at the time of the Centennial of Progress, the third at the Statler Hotel in Washington, D. C., on November 12, 1952, and the fourth at the Illini Center in Chicago on February 20, 1953.

The September 4th meeting was devoted entirely to a consideration of the problems originating with the new Air Force ROTC program. A number of guests were invited including representatives of the Air Force led by General Deichelman. Out of the meeting a better understanding of the objectives of the new program was obtained and the results of the discussion were circulated by means of the *ECAC Bulletin* of October 7.

The meeting of September 5 dealt largely with the organization and plans for the operation of the committees.

The meeting of November 12 was a special session primarily for those members attending the Convention of the Association of Land-Grant Colleges and Universities, and was devoted to continued planning of committee activity and preliminary planning of the program at Gainesville. In addition, the agenda for a meeting to be held the following day with representatives of the Mutual Security Administration and the Technical Cooperation Administration were discussed.

At the February 20 meeting, final completion of the program at Gainesville was accomplished. The growth of the organization known as the Engineers and Scientists of America was discussed and it was agreed that President Woolrich should be invited to prepare a statement to acquaint engineering deans with the growth and plans of this organization. Reports of committee projects of the year were given. An important program was the review of the Army and Air Force ROTC developments which took not only the form of the special meeting of September 4 and the subsequent dissemination of the discussion, but also several meetings in Washington with representatives of the Army and Air Force officers attended by the Chairman of the Military Affairs Committee, Dean William Allen, the Chairman of the Council, Dean J. H. Lampe, and the President of the Society, Dean Woolrich.

Projects of the Year

On November 13 the joint meeting of the ASEE with the representatives of the Mutual Security Agency and Technical Cooperation Administration was held at the State Department and was presided over by Chairman Lampe. As a result of this meeting a new committee of the Engineering College Administrative Council was appointed by Dean Lampe which will be advisory to the MSA and TCA. The chairman of this committee is R. A. Morgen. A meeting of this committee was held on February 16. It was particularly emphasized that all approaches by MSA-TCA to individual faculty members should be through their deans rather than directly and arrangements were made for the submission of possible candidates by deans to the chairman.

Dean Pierce of the Committee on Relations with Secondary Schools has been developing cooperation with the American Mathematical Association and the National Council of Teachers of Mathematics, in a proposed study of High School-College articulation in the field of mathematics. Representatives of all the groups involved met at Atlantic City April 10 and 11. Dean Pierce was authorized by the Executive Council to cooperate in the planning and to attempt to secure funds from a Foundation for the implementation of such a program.

News Bulletins

ECAC News Bulletins were circulated three times to our institutional, associate and affiliate members, and to the ASEE officers and council members.

Programs

The Engineering College Administrative Council has also developed programs for two national meetings. The first was held in connection with the Centennial on Engineering on Friday afternoon, September 5 and was presided over by Chairman Lampe. The topic was "1920–1952: What Are the Contemporary Demands on Engineering Curricula." The panel included five speakers, one for each of the areas represented by the Founder Societies.

The Council sponsored several sessions at the annual meeting at Gainesville including:

1. a general session on Thursday morning,
2. a joint conference with the Mathematics Division on Wednesday afternoon,
3. a program by the International Committee on Tuesday afternoon on "Cooperation with Engineering Education in Other Lands,"
4. the always popular International dinner on Tuesday evening, and
5. the Friday Executive Session for Institutional Representatives.

Respectfully submitted,
J. H. LAMPE, *Chairman*
W. L. EVERITT, *Secretary*

Teaching Positions Available

The following rules were adopted by the General Council of the ASEE:

The privilege of advertising for teaching positions is extended only to colleges and technical institutes which are either Active or Affiliate Institutional Members of the ASEE. Advertisements must be for positions available only. No advertisements will be accepted for an individual seeking a job.

Advertisements must be submitted not later than the first day of the month preceding the month of issue. Because of limited staff, the ASEE headquarters cannot maintain personnel files or supply detailed information about jobs. In replying to blind ads, address letters to American Society for Engineering Education, Northwestern University, Evanston, Illinois and give blind ad number. Information and rates for advertising in the Journal can be received by writing ASEE Headquarters. In order to conserve space and achieve uniformity, the privilege is reserved to rearrange advertisements.

PRESIDENCY VACANT AT SOUTH DAKOTA SCHOOL OF MINES AND TECHnology, Rapid City, South Dakota, a school offering bachelor's and master's degrees in engineering and science only. Applicants must have Ph.D. degree in engineering, academic engineering and administrative engineering experience. Faculty of 60. Contact Eric Heidepriem, Regent of Education, Custer, South Dakota.

INSTRUCTOR OR ASSISTANT PROFESSOR OF ELECTRICAL ENGINEERING (Power). At least B.E.E. required. Appointment immediately or February, 1954. Apply to Dean, School of Engineering, University of Virginia, Charlottesville, Virginia.

Annual Report of Engineering College Research Council

The last year has seen the continued growth of research and development in the United States to a point where both money spent and people engaged in research exceed any previously recorded figures. The engineering colleges have shared in this growth. It is now estimated that something over $3 billion is being spent in the United States each year on research and development. This growth of research in government was greatly stimulated by World War II and it was during this period that the military department began to appropriate large sums for these purposes.

In the fiscal year ending July 1, 1952, the Government spent $1.84 billion for research and appropriations were even higher than this. It is expected that expenditures will amount to $2.1 billion in the fiscal year ending June 30, 1953, and in the two following years there will be a leveling off at about 2.2 billion and 2.3 billion dollars respectively. Of these amounts, it is possible to identify that being spent in non-profit organizations (colleges, research foundations, etc.), and apparently about $72 million is being spent by the Federal Government in non-profit organizations for basic research. In addition it is spending about $175 million for what is called applied research, and about $75 million is being spent for engineering and development purposes. In 1951 about $23 million was spent on plant and facilities by these non-profit organizations and this figure fell to $20 million in 1952.

It appears that the amount of money being appropriated by industry from its own funds for research and development has reached a temporary plateau for it has remained somewhere between $1.2 billion and $1.3 billion for the last three years. In addition to the funds cited above, which come from the Federal Government, engineering colleges are doing research for industry as well as performing some basic research with their own funds. The magnitude of these funds is more difficult to identify. The amount of work being done by universities in general has increased about $20 million per year for the last five years; so, at the present time, total funds available in universities for research and development are approximately $280 million. Obviously a large fraction of this total originates in the Federal Government and many colleges are becoming quite apprehensive of the effects of cuts in the Federal research and development program. Since Federal funds must be divided between three large customers, of which the smallest share goes to universities, little actual savings can be realized by cutting the universities' shore. On the other hand, there are reasons for concern because industrial laboratory research sponsored by the Military is often closely tied to production contracts and contracts for pilot models and tooling which, in all probability, will have to continue. Much Government research is done in government-owned establishments which have no other function and which are often founded on large and expensive facilities, such as proving grounds and wind tunnels. These must be maintained for national security. With both industry and Government laboratories having a priority on a portion of the Government's research dollar, colleges wonder if they might not be cut much more than they are prepared to accept. Unfortunately, many colleges have made commitments to staff and build-

ing programs which cannot be abrogated and which would represent a real burden if the colleges were expected to finance them alone.

Shift in College Research

There has been a noticeable shift in college research from development, and even engineering, to the more basic kinds. The Department of Defense has helped in this regard by setting up special offices to encourage and help support such research. The Office of Naval Research of the Navy Department is well known in this respect and it has been joined more recently by the Office of Ordnance Research of the Department of Army and the Scientific Research Office of the Air Force. All three of these organizations are now making grants for the support of basic research. The National Science Foundation not only makes grants for research but also supports fellowships in Engineering Sciences. However, rightly or wrongly, none of the grants made by these four organizations cover the total and complete costs of the research. Althought the first three pay an overhead based on an audit of the college's expenses and the last allows a fixed percentage on the sum of the grant which does not differ from college to college, the engineering schools themselves must recognize that in taking on such contracts, or accepting such grants, they undertake some additional financial obligation. However, if these grants are regarded as seed corn to stimulate research or as a method by which the college can multiply the effect of funds it has from its own resources for research, the result can only be counted as a good one.

The Engineering College Research Council recognizes and is pleased with the activities of these organizations in trying to stimulate research in some small schools and in areas which do not have a tradition of creative thinking in engineering. By strengthening these areas and these schools, all of the engineering colleges are strengthened.

Again the engineering colleges, in a spirit of self-examination, are beginning to question why they indulge in development work and even in engineering. It is fairly obvious that in times of national emergency the colleges must devote themselves to the more practical aspects of science. Unless it is admitted that we are to live in a continual state of emergency, this reason has long since ceased to exist. On the other hand, there are some clear thinkers in education who say that engineering schools must continue to do some engineering work. Their line of reasoning is something like this:

We now expect all of our engineering teachers to be at the forefront of scientific knowledge. This requires they be familiar with the research that is going on in their particular fields. Second, we contend that engineering is a practical science and engineering teachers, in order not to mislead their students, must know how things are done in the engineering profession. Third, and most important of all, engineering by its very nature is a creative profession and therefore an engineering teacher must not only understand science but must know how to do engineering in a creative way. Where is he going to get the necessary experience and where is he to practice his engineering? Obviously he can do it by consulting, and although this helps him both as a professional man as well as financially, few if any benefits accrue from such labor to his principal employer, the engineering school. For many years, medical schools have been closely associated with hospitals and clinics where the professional staff can practice its profession. Is not this a practice which should be followed by engineering schools? Should not all schools have departments of Engineering Research, institutes, or engineering experiment stations in which the staff itself can practice engineering? Lastly, in this practice of engineering, will it not be possible to assist Government and industry, and especially small industries, to get a start on engineering programs? While doing this, is it not possi-

ble to combine the science and education of engineering and also support graduate students financially while providing them with the instruction in research which is so necessary for advance degrees? Although a committee of the Engineering College Research Council is still groping with these thoughts and trying to formulate them in an understandable manner, it is hoped before long they can be issued as a policy which can be advanced for adoption by the Research Council itself.

Too Few Graduate Students

It is believed by most engineering college research workers that the number of graduate students now in our schools of engineering is far too few. This is brought about by two factors: first, the generous salaries now being paid our graduates by industry who need them as quickly as possible to add to their engineering strength and, second, by the few and relatively low paid fellowships and opportunities for earning available for graduate students. The grants being made by the Department of Defense agencies have been a tremendous help in alleviating this need, but more must be done by industry if we are to have a continuous and sufficient flow of men with advanced degrees into the engineering profession.

The Engineering College Research Council is cognizant of the tremendous opportunity it has in rendering service to the small business of the country. Big business needs no selling on the advantages of conducting a virile research program and in applying the results of that research to their products. Many small industries have never tried this, either because they feel they cannot finance such a program, because they do not know how to start a program of research, or because they are not familiar with its benefits. This too is a field of opportunity in which the Engineering College Research Council has not yet formulated its plans and on which it hopes to do something within the next year.

The committee of the Engineering College Research Council which has worked hardest is that under the direction of Mr. Raymond Woodrow of Princeton University on Contract Relations with Federal Agencies. This committee has met many times for sessions lasting more than one day to work out the details of the engineering colleges' relationships with various agencies of the Federal Government. Many of these problems have been vexing and hard to resolve, but a point has been reached with a good many of the Federal agencies so they now wish to confer with this committee before making any changes in the usual contract procedures. Fortunately, the benefits of these discussions have accrued not only to members of the Engineering College Research Council but to all of those who hold similar contracts. This committee has concerned itself almost entirely with the programmatic type of research where colleges expect the Military or other Government agencies to cover the complete cost of such research. Every ECRC representative in each member institution has been informed of this committee's activities by receiving the minutes of all meetings and copies of all proposals made by representatives of Federal agencies. If by chance any institution has failed to receive this information, a check should be made directly with Mr. Woodrow to find out to whom such material has been mailed.

Many members of the Engineering College Research Council have served on the panels or committees of the Department of Defense's Research and Development Board. Many of these men have shared a feeling of frustration and have wondered if their services were being properly utilized and if proper cognizance was being taken of the results of the time and energy which they had spent in resolving scientific problems of considerable importance. It is with some feeling of loss that wo note the passing of the Research and Development Board and await with interest the results of the various pro-

posals to set up Assistant Secretaries for Research and Development in the Department of Defense. It is hoped that any Council on Research or any other body set up to advise on or to administer the Department of Defense's research program will be a truly effective body. The Engineering College Research Council offers its services in any capacity it can to make this program an effective one to increase the strength of this nation's defenses.

Much energy has been expended on the 1953 "Review of Current Research" in which the work of some 103 colleges is listed. Although an exact account has not been made, it is estimated that this represents some 8,000 research projects which, of course, vary widely in scope and which cover what appears to be the whole gamut of physical science. This Review, which now totals over 300 pages, contains an index listing some 7,000 separate topics giving a small idea of the scope of such research.

Year of Transition

The past year has been one of transition for the ECRC in that a new chairman was elected and a new secretary had to be found. This followed a period during which the former secretary was not able to assist in our work and during which we had to run on our previously attained momentum. We are now slowly getting going again.

The Council notes with sorrow and a feeling of personal loss the untimely passing of Professor A. A. Jakkula of the Texas A. & M. College who had served for the past two years as a member of the ECRC Executive Committee.

As Chairman of the Council, I would like personally to thank each and every member who has helped make this past year a success. The Secretary, the Executive Committee, and the members of all of our committees have worked hard. Many college representatives have made suggestions as to how we can be a more effective agent in expanding the Engineering College Research programs. We will welcome ideas from any sources on this constructive theme.

Respectfully submitted,

ERIC A. WALKER,
Chairman

Review of Current Research Available . . .

You can now get your copy of the "Review of Current Research and Directory of Member Institutions," published by the ECRC, which is just off the press. This is a complete directory of research projects in engineering colleges throughout the country. For a copy write to Professor Virgil Neilly at Pennsylvania State College, State College, Pa. The price is $2.50.

Report for 1952-53 of the Vice President for Divisions and Committees

In his report last year my predecessor in office, Dr. L. E. Grinter, called attention to the increasing number of Instructional Divisions of the Society and to the importance of sustaining the vigor and fruitfulness of their activities. Specifically, he suggested the desirability of relating membership in the Instructional Divisions to the work of the comprehensive study that the Society had in prospect looking toward an evaluation of engineering education.

Under Dr. Grinter's able leadership the evaluation study has gone forward during the current year with members of the Instructional Divisions, organized into institutional committees, contributing helpfully to the progress of the undertaking. It is my belief that as the findings of the evaluation study are developed there will be yet greater opportunities for the Subject Matter Divisions to participate in this project by taking responsibility for delineating in greater detail some of the specialized aspects of curriculum proposals that may be suggested by Dr. Grinter's Committee. This will serve to extend in depth the activities of the Committee on Evaluation and help make the results of this comprehensive study increasingly useful to engineering colleges.

Several Divisions of the Society held semi-annual meetings during the past winter. The Division of Engineering Drawing met at the University of Nebraska, January 29 to 31, centering its program particularly around problems of manufacturing and design. A very successful workshop program was arranged by the Co-operative Engineering Division at Fenn College in Cleveland on January 22 and 23. The Division also worked earnestly throughout the year with the American Council on Education and with the Veterans Administration on special problems of Public Law 550 affecting students in co-operative colleges. Over three hundred representatives of industry and of engineering education met at Northwestern University on January 31 for the conferences sponsored by the Relations with Industry Division. Particular attention in this program was given to problems of engineering manpower and the recruitment of potential engineering students from the high schools.

Specialized Publications

A number of the Divisions of the Society have issued, from time to time during the year, specialized publications which have proved to be very helpful as supplements to the JOURNAL OF ENGINEERING EDUCATION. Among these are the *Civil Engineering Bulletin,* the *Journal of Engineering Drawing,* the *Machine Design Bulletin,* the *Heat Power News, Chemical Engineering Abstracts,* and the *Engineering Mechanics Division Bulletin.* These bulletins are financed by the Divisions, are ably edited, and contain many articles of timely interest and importance.

Under the leadership of Professor Ireson of Stanford University, the Industrial Engineering Division sponsored a summer school immediately preceding the Annual Meeting of the Society at the University of Florida. The theme of the summer school was "Quantitative Measures in Industrial Engineering Courses." The Seminar for Engineering Teachers, begun so auspiciously last year by the General Electric Company and the Society's Committee on Improvement of Teaching, has been continued this year sponsored jointly by the General Electric Company and the

Educational Methods Division of the Society. Dr. B. R. Teare again served as the Society's representative in the planning and conduct of this program which was held at Schenectady immediately preceding the Annual Meeting of ASEE. The Society is indebted to Vice President Boring for his initiative in conceiving this very serviceable program and for his good offices in obtaining financial support for it.

An innovation in the Annual Meeting Program for 1953 is the scheduling of a General Session given over to brief reports of important Society Committees for the purpose of familiarizing the membership with these activities and providing an opportunity for questions and discussion. Among the Committees reporting at this meeting are the Committee on Teaching Aids, which has prepared a bulletin listing teaching aids of special utility in various fields of engineering instruction, the Committee on Ethical Standards, and the Committee on Engineering Manpower. A panel discussion of the important work carried on during the year by the Committee on Evaluation of Engineering Education also forms part of this General Session.

Joint Meetings

The trend toward more joint meetings of Divisions and Committees has been continued at the Annual Meeting this year as a result of worth while experience with this type of program in the recent past. In general, too, a policy of fewer separate meetings and concentration of effort to get outstanding speakers has proved to be most satisfactory.

Mention should be made in this report of the fine work initiated during the year by two new Committees of the Society: the Committee on Recognition and Incentives for Engineering Education, and the Committee on Improvement of Society Functions.

One of the problems that always faces Committees and Divisions of the Society is that of finding a way to get together for the discussion of work that is being carried on. In an effort to provide an opportunity for round the table conferences of this kind, arrangements will be made for providing meeting rooms next fall at the Annual Meeting of ECPD, ECRC, and ECAC in New York at the Hotel Statler in mid-October. It is hoped that many of our Divisions and Committees will take advantage of this opportunity for discussion of common problems. Wednesday, October 14, has been suggested as the day when Committees of the Society might meet to best advantage without conflicting with meetings of the other organizations.

In concluding this report I am glad of the opportunity to express the sincere appreciation of Secretary Bronwell and myself for the very fine co-operation that has been given by chairmen and secretaries of Divisions and Committees of the Society. Their responsiveness to requests for information and the effectiveness with which they have planned their activities and the program for the Annual Meeting are highly commendable. It has been a great pleasure and privilege to work with them.

Respectfully submitted,

WILLIAM C. WHITE,
Vice President

Report for 1952-53 of Vice President in Charge of Sections and Branches

The major responsibility of the office of the Vice President in Charge of Sections and Branches for the year 1952–1953 has been concerned with the promotion of the "Paper Contest" for young engineering teachers, and with the problem of the unionization of engineers. These problems have been called to the attention of the Sections and Branches and they have all been active.

Invitations have been sent to the bordering Canadian Colleges to join those Sections of our Society adjacent to their physical locations and the aid of Colonel L. F. Grant, Chairman, Engineers' Council for Professional Development, has been solicited in furthering this project. Contacts with the Canadian colleges indicate that eventually they may wish to organize their own sections but as an interim move it has been suggested they join up with their United States associates.

Physical boundaries of the Missouri Section were changed to include the University of Arkansas, and it is now officially known as the Missouri-Arkansas Section.

Section activities have been at a high level throughout the country and many of the Section meetings have been attended by officers of the Society. I feel the Sections and Branches of the Society are in good order.

Respectfully submitted,

MAYNARD M. BORING,
Vice President

ANNUAL MEETING

June 14-18, 1954

University of Illinois **Urbana, Illinois**

Lamme Award

The Committee on Lamme Award is always anxious to get nominations for the Award from the membership of the Society. Any member may place a name in nomination; the selection will be made by the Committee by letter ballot.

The Lamme Award consists of a gold medal and bronze replica bestowed annually upon a distinguished engineering educator for excellence in teaching and contributions to the art of teaching; contributions to research and technical literature; achievements which contribute to the advancement of the profession; and engineering administration. The Lamme Trust Fund was established in memory of Benjamin Garver Lamme. For a brochure describing the Award and a nomination form, please write to the Secretary, Professor A. B. Bronwell, Northwestern University, Evanston, Illinois.

Nominations should be sent to the Chairman of the Committee, Dean F. E. Terman, College of Engineering, Stanford University, Stanford, California by February 1, 1954.

The George Westinghouse Award

The George Westinghouse Award is an annual award established in 1946 by the Westinghouse Educational Foundation to recognize and encourage outstanding achievement in the teaching of students of engineering. The Award consists of $1,000, together with an engraved certificate.

The Award has been established to encourage younger men who have shown by their past record, evidence of continuing activity as superior teachers. To them the Award may serve not only as a reward but as an incentive toward further achievement.

In order to achieve this intent, it is deemed essential to limit the Award to those who have not reached the age of 45 by the date of the annual presentation.

Nominations may be made by any person, organization, or group and are to be submitted before February 1, 1954 to the Chairman of the Committee on Award, Professor F. H. Pumphrey, University of Florida, Gainesville, Florida before February 1, 1954. Nominations must be made on forms available from either the Chairman of the Committee or from the Secretary of the Society. Nominations should be accompanied by significant evidence supporting statement and claims.

U. S. Army Scientific and Professional Personnel Program

The U. S. Army Scientific and Professional Personnel Program should be of special interest to recent engineering graduates who will shortly be inducted into the armed forces because it was designed to channel as many such persons as possible into Army billets which will insure the maximum utilization of their engineering or scientific training and experience for their own continued professional development and for the advancement of the Army's technical programs.

The program is described in detail in Department of the Army Special Regulation No. 615–25–11, dated 7 August 1952.

The regulations provide for the identification, classification, assignment, and utilization of those persons who are qualified to perform scientific and professional level duties in research and development, instruction and related work of professional or scientific nature.

Commanders of reception centers and other installations conducting initial reception processing are responsible for the proper identification and indoctrination of scientific and professional personnel and for their transfer to appropriate basic training.

Copies of the basic regulation are available from the Department of the Army, Washington 25, D. C.

The Engineering Manpower Commission of Engineers' Joint Council is very interested in the efficiency of the Scientific and Professional Personnel program. It feels that the dissemination of information regarding the existence of the program is vital to its success and would appreciate information regarding engineers and scientists qualified under the program who are not being utilized in their fields of special qualification.

Reprints Available . . .

Are you interested in receiving copies of the newly completed "Manual of Graduate Study" or the "Report of the Committee on the Improvement of Teaching"? Copies of these can be obtained from the Secretary's Office, the price of the Graduate Manual being 50¢ and that of the Report of the Committee on the Improvement of Teaching being 15¢ each or $8.00 per hundred. All orders should be accompanied by a check remittance.

Cooperative Research*

By FRANCIS M. DAWSON
Dean, College of Engineering
and
ALI BÜLENT ÇAMBEL
Assistant Professor of Mechanical Engineering, State University of Iowa

It is fortunate indeed that American industrialists realize the need for industrial research and promote it whenever feasible. Notwithstanding, there is evidence that the executives of our industrial family have not fully benefited from the potentialities of research. Many a company loses ground because it has no research department or because its existing research department is limited as far as personnel and physical facilities are concerned.

In this article an attempt will be made to explain how an industrial concern may enhance its research activities economically by asking capable engineering schools to assume the technical responsibility of necessary investigations.

Whether applied or fundamental, industrial research requires many things. Three of the most important are: 1) source material, 2) engineers and scientists, and 3) shops and laboratories.

Source material is needed because all research requires a knowledge of the previous investigations completed in the field. Much time and money may be conserved by knowing that a certain study is already completed and thus need not be repeated again. Schools of higher learning have excellent libraries in which may be found almost all of the technical books, journals and other communications. Furthermore, engineering professors frequently act as reviewers to learned magazines and to publishers and therefore are intimately familiar with some of the most recent developments in the technical field.

All industrial research requires the talents of engineers and scientists. Here again engineering schools may serve very satisfactorily because their faculties are composed of high caliber technical and scientific personnel. The teaching and research staffs of engineering schools include people who are trained in industrial applications as well as professors who have a good command of both theoretical and experimental research methods. These experts are trained and educated in diverse fields, and it would indeed be difficult for the average industrial company to gather together people with so many different experiences. Engineering teachers, being well versed in the fundamentals of science, may frequently undertake an investigation in a more economical way than might be suggested by a person who is not as familiar with the basic premises of a science.

In industrial research every theory must be proved experimentally and every design or new device must be tested for performance. This requires shops and laboratories. University and technology laboratories and shops are well equipped and may boast of equipment which is multifarious in scope and function.

So far the qualifications for industrial research have been discussed. It would be well to explain briefly how such work may be undertaken. Of course the details will vary depending upon the school initiating the study, the company assigning the problem and the problem itself.

Three Ways

Three ways of undertaking industrial research are: the awarding of contracts,

*Based on a discussion conducted during the "Industry and Education Conference" at the State University of Iowa, May 28, 1952.

the awarding of fellowships, or the employing of consultants.

In the contract plan a concern contracts that the school under consideration shall execute a certain investigation to determine specific phenomena. The college, in assuming the responsibility for the work, assigns members of its staff to carry out the solution of the problem in the best possible manner.

In the fellowship plan the problem to be investigated for the company is assigned to a graduate student as a thesis project. The fellowship recipient is an outstanding graduate engineer and works under the guidance of an experienced staff member who advises the student in his work.

Under the consultation plan an organization enters into a direct agreement with an engineering educator who is known to have a successful experience in the field of study.

The plan according to which a problem is to be investigated depends on the prevailing conditions. Some studies lend themselves better to fellowships while some may be effected more advantageously by contract. Irrespective of the plan chosen there are certain unwritten rules which may greatly improve the chances of a successful investigation and which may contribute towards a cordial company-school relation. These may be cited briefly as follows:

Rules for Successful Investigation

1) Any investigation, regardless of its form, should be arranged on the basis of a written agreement signed by the responsible authorities of both the school and the company. Oral agreements are not advisable and they often cause serious misunderstandings.

2) Both the sponsoring company and the contracting institution should each assign a qualified person to the project to maintain proper liaison and communication.

3) Periodic reports should be submitted by the school to the company. However, these should be scheduled so that the time of the research personnel is not monopolized by the preparation of the progress reports.

4) In general an investigation which is assigned to a school should be of a long term nature rather than an immediate need. Anything which must be solved in a very short time is not well suited to university type research unless it is very limited in scope.

5) The investigation should be undertaken as freely as possible. Any unnecessary restrictions guised under security or competition are not conducive to high caliber research.

6) In assuming the responsibility for an investigation the school should be certain that it is not competing with existing consulting firms or research institutes. This is especially true in the case of state or municipally supported schools. There are numerous investigations which consulting firms can not easily undertake and it is in this area that engineering schools may serve best.

7) In order that a school be a top institution, it is necessary that its faculty and students engage in research. It is only in rare instances that a person can be a great teacher without being a pioneer in his field of study. On the other hand students can mature into capable engineers only if they study in an atmosphere where technology is actively advanced. It should be remembered, however, that a school should never undertake research activities to the extent where its educational activities commence to suffer.

Conclusion

In conclusion it may be said that both schools and industry benefit from investigations initiated by mutual agreement. The challenges of industrial research oblige engineering schools to rise to new heights in science, technology and education. For industry, the results of academic research serve as an economical guide for better products and manufacturing techniques.

Report of the Treasurer

THE AMERICAN SOCIETY FOR ENGINEERING EDUCATION
COMPARATIVE BALANCE SHEETS

Assets	June 30, 1952	June 30, 1953
General Fund:		
Cash—State Bank & Trust Co., Evanston	$29,627.76	$27,826.54
Petty Cash	300.00	300.00
U. S. Government Bonds Series G	30,700.00	30,700.00
Accounts receivable		
Advertising	2,747.44	3,588.01
Dues	1,800.00	1,800.00
Westinghouse Educ. Found.	323.69	474.01
Due from Lamme Fund		279.58
Income Cash in Hands of Lamme Trustee	133.86	
Prepaid Travel Expense	425.00	425.00
Inventory (nominal)	1.00	1.00
Furniture and Fixtures (Nominal)	1.00	1.00
	$66.059.75	$65,395.14
Life Membership Fund:		
Cash	209.95	212.06
U. S. Government Bonds Series G	1,000.00	1,000.00
Due from General Fund		25.00
	$ 1,209.95	$ 1,237.06
B. J. Lamme Fund:		
Cash	163.08	290.25
Income Cash in Hands of Trustee	—	237.25
Principal Cash in Hands of Trustee	9.00	3.86
Securities and Mortgages	5,132.73	10,137.87
	$ 5,304.81	$10,669.23
Liabilities and Capital		
Current Liabilities:		
Accounts Payable—Publications	—	—
Due to Life Membership Fund	—	25.00
Other Accruals	407.88	4,234.56
	$ 407.88	4,259.56
Dues Collected in Advance	508.25	864.21
Excess of Contributions over Disbursements		
Teaching Aids	6,975.12	6,228.11
Evaluation of Engrg. Educ.		187.30
	$ 7,483.37	$ 7,279.62

	June 30, 1952	June 30, 1953
Surplus:		
Reserve for Special Projects	$ 6,004.69	$ 5,317.19
Reserve for ECRC	6,056.62	4,253.16
Unappropriated Surplus	46,107.19	44,285.61
	$58,168.50	$53,855.96
	$66,059.75	$65,395.14
Life Membership Fund—Surplus	$ 1,209.95	$ 1,237.06
B. J. Lamme Fund:		
Due to General Fund	—	279.58
Surplus	5,304.81	10,389.65
	$ 5,304.81	$10,669.23

COMPARATIVE STATEMENT OF CHANGES IN SURPLUS AND SPECIAL ACCOUNTS

	12 Months Ended June 30, 1952	12 Months Ended June 30, 1953
General Fund—Unappropriated Surplus		
Balance at Beginning of Period	$41,838.71	$46,107.19
Add: Excess of Income over Expense	10,273.17	
Transfer to ECRC Reserve	(6,004.69)	
	$46,107.19	$46,107.19
Less: Excess of Expense over Income		3,491.18
Transfer from ECRC Reserve		(1,803.46)
Transfer of Income Cash to Lamme Fund		133.86
Balance at End of Period	$46,107.19	$44,285.61
Life Membership Fund		
Balance at Beginning of Period	$ 1,183.11	$ 1,209.95
Add: Contribution to the Fund	25.00	25.00
Interest on Fund	1.84	2.11
Balance at End of Period	$ 1,209.95	$ 1,237.06
B. J. Lamme Fund		
Balance at Beginning of Period	$ 5,372.19	$ 5,304.81
Add: Transfer of Income Cash for General Fund		133.86
Contribution Received		5,000.00
Earnings of the Fund	228.62*	230.56
	$ 5,600.81	$10,669.23
Less: Award and Expenses	296.00	279.58
	$ 5,304.81	$10,389.65

* Includes earnings of prior year $102.47.

COMPARATIVE STATEMENT OF CHANGES IN SPECIAL ACCOUNTS

	12 Months Ended June 30, 1952	12 Months Ended June 30, 1953
Receivable—Westinghouse Educational Foundation		
Balance at Beginning of the Period	$ 83.91	
Add: Expenses	399.69	
	$ 483.60	
Less: Reimbursement Received	159.91	—
Balance at End of Period	$ 323.69	
Teaching Aids Fund		
Balance at Beginning of Period	$ 4,362.50	$ 6,975.12
Add: Contributions Received	3,605.00	50.00
	$ 7,967.50	$ 7,025.12
Less: Disbursements	992.38	797.01
Balance at End of the Period	$ 6,975.12	$ 6,228.11
Evaluation of Engineering Education Fund		
Balance at Beginning of Period	—	—
Add: Contributions Received	—	$ 6,000.00
Less: Disbursements*	—	5,812.70
Balance at End of the Period		$ 187.30

* Includes $3,300 payment on contract for part-time secretarial services.

COMPARATIVE STATEMENT OF INCOME AND EXPENSE

	12 Months Ended June 30, 1952	12 Months Ended June 30, 1953	Budget 1953-54
Income:			
Current Dues—Individual	$39,719.28	$40,394.45	$40,600
Institutional	8,105.00	9,185.00	10,000
Sale of Publications	2,069.32	2,887.00	2,800
Advertising	10,896.21	13,390.97	18,500
Interest on Bonds	792.50	792.50	780
ECRC	3,560.86	247.08	
B. J. Lamme Fund	12.40		
Refund from EJC	407.71		
Refund of Unused Registration Fee of 1952 Meeting		689.24	
Miscellaneous		269.95	
Total Income	$65,563.28	$67,856.19	$72,680

	12 Months Ended June 30, 1952	12 Months Ended June 30, 1953	Budget 1953–54
Expense:			
Cost of Publications	$22,884.88	$26,062.46	$30,000
Administrative, Secretarial and Clerical Salaries	12,658.51	19,573.06	21,100
Retirement Emeritus	1,360.00	1,360.00	1,360
Travel—Secretary's Office	1,878.71	1,906.51	1,950
Postage, Telephone and Telegraph	1,565.83	2,364.13	2,400
Supplies and Sundry Printing	3,171.05	4,342.65	4,500
Dues—American Council on Education	100.00	200.00	200
Dues—EJC	—	204.00	550
Contribution—ECPD	500.00	500.00	500
Contribution—Life Membership Fund	25.00	25.00	25
Officers Travel	2,365.99	1,886.57	2,500
Meeting Expense	2,214.34	3,069.30	2,500
Expenses ECAC	1,126.99	1,301.37	2,200
Expenses ECRC	1,906.17	6,400.54	4,350
Committees and Conferences	658.22	926.16	1,300
Bonding, Auditor's and other Society Fees	296.59	359.84	
Special Projects and Miscellaneous			1,000
Purchase of Dictaphone	764.35		
Committee on Improvement of Teaching	815.64		
Purchase of Mimeograph	1,062.84		
Credit Received on IBM Typewriter	(65.00)		
Contribution to ECPD for Eval. of Engrg. Ed.		100.00	
Young Engrg. Teachers Award		300.00	
Graduate Manual		367.80	
Cooperative Engrg. Educ. Report		95.48	
Miscellaneous		2.50	
Total Expense	$55,290.11	$71,347.37	$76,435.00

COMPARATIVE STATEMENT OF INCOME AND EXPENSE

	12 Months Ended June 30, 1952	12 Months Ended June 30, 1953	Budget 1953–54
Total Expense	$55,290.11	$71,347.37	$76,435
Net Income (Net Loss) for the Period	10,273.17	(3,491.18)	
* Transfer from (to) ECRC Reserve	(6,004.69)	1,803.46	
Balance to General Fund Surplus	$ 4,268.48	($1,687.72)	($3,755)

Parenthesis indicates deficit.

* This transfer was authorized by the Executive Board June 25, 1952, in order to smooth the fluctuations in ECRC expense from year to year. The amount is calculated as the difference between expense and the sum of receipts and budgeted expenditures.

Minutes of Executive Board Meeting, Northwestern University, Evanston, Illinois, September 9–10, 1953

Meetings of the Executive Board of The American Society for Engineering Education were held at Northwestern University, Evanston, Illinois on September 9 and 10. Those present were: L. E. Grinter, *President*, W. L. Everitt, B. R. Teare, Jr., E. A. Walker, G. Farnham, A. B. Bronwell, C. E. Watson and M. Strohm.

Future Executive Board Meetings

The Executive Board discussed the schedule of Board meetings for the balance of the year. The next meeting will be held at the Engineers' Club, New York City on October 14 at 8:00 A.M. There will probably be a meeting in January, 1954 in New York City at the time of the AIEE Convention and, if necessary, a meeting in either March or April. The final meeting will be held at the time of the Annual Meeting in June.

The importance of having a member of the Executive Board present at Section meetings was discussed. Vice President Teare will write to Sections about arrangements for representation of the Executive Board at their meetings. The meetings west of the Mississippi involve considerable travel expense and do not fit into any kind of travel pattern. However, President Grinter will try to attend some of these.

Report of the Secretary

The Secretary reported on the plans for publication of the Report of the Committee on Financial Policy. The Board discussed means of informing the Society membership of the proposed plan for change in dues.

The Executive Board voted that a revision of the By-Law IV be prepared for submission to the General Council. If favorably adopted, this will be sent to the Society membership by letter ballot during the year.

The Executive Board voted that the dues should not be raised more than $1.00 in any given year.

The Secretary reported that appointments to the various Society committees have been nearly completed.

The Secretary will present a plan for hospitalization and Social Security for office staff to the Executive Board at the October meeting. At present the office secretaries have no hospitalization or Social Security benefits. Professors Bronwell and Watson are adequately covered by their affiliation with Northwestern University.

The Secretary reported that the Engineers' Joint Council is working with the National Science Foundation in the preparation of a roster of engineering personnel. This will consist of a finder list of 5000 people, distributed through all engineering occupations. In case of emergency, persons on this finder list will be consulted for personnel in their respective fields.

Report of the Treasurer

The Treasurer presented the final Annual Audit for 1952–53. This showed a deficit of $1688. This deficit was about $600 larger than anticipated in the preliminary audit. The Secretary explained that this occurred because the cost of printing Annual Meeting programs and the expenses of committees and conferences were both higher than had been anticipated when the preliminary audit was prepared. The Board voted to accept the Treasurer's Report.

Reports of Vice Presidents

Vice President Walker reported that sales of the *ECRC Review of Current Research* are going well. He felt that there ought to be advertising in the next issue of the *Review* to help cover publication costs and that the price should be raised. The *Review*

has been given excellent reviews in the technical press. Two copies were sent to all Institutional members. The Board suggested that copies of the *Review* be sent to members of the General Council.

Vice President Everitt reported that there will be an ECAC Executive Committee meeting on October 15 in New York City, at which time the Administrative Council will formulate its plans for the year. The August *ECAC Bulletin* contains information on ECAC operations and Committees. It was suggested that the *ECAC Bulletin* be sent to members of the General Council as one means of keeping them informed on Society functions.

Vice President Teare reported that he is preparing a letter which will be sent to ASEE Sections. He felt that there should be closer cooperation between Sections and Divisions in working on problems of mutual interest and in planning meetings. Dean Teare suggested that an effort be made to invite representatives of Associate Institutional members (company members) to attend Section meetings. Lists of Associate Institutional members will be sent to Section Chairmen. Vice President Teare reported that the Southeastern Section is planning to organize its Section along structural lines similar to those of the National organization, and that the Allegheny Section wishes to enlarge its Branch.

The Secretary reported that Vice President White had been in close touch with Officers of Divisions and Committees and had prepared an informative letter to go to all Division Chairmen.

ECPD Dues

The Executive Board reviewed a letter from the Engineers' Joint Council for Professional Development relating to an increase in contributions from constituent societies. In this proposal, the ASEE contribution would be increased from $500 per year to $700 per year. The Executive Board voted to request ECPD to establish a definite plan for levying contributions which would be adhered to in the future.

ASEE Sponsorship in Rapidly Developing Areas of Science and Technology.

The Executive Board considered the sponsorship of conferences of perhaps one or two weeks duration in the more rapidly advancing fields of sciences and technology. It was pointed out that the types of programs which ASEE sponsors at present allow very little depth of penetration. When curricular changes take place, they usually occur as a result of new advances in science and technology. It would seem therefore that a more thorough study of the newer fields of science and technology might be very helpful in appraising future trends in engineering education. It was suggested that the cooperation of industry be sought in financing the conferences and providing research engineers for programs.

This proposal has been submitted to the General Council. The Council recommended that a committee be appointed to study and implement the proposal. A meeting of the Chairmen and Council representatives of Divisions has been scheduled for October 14 to discuss this proposal.

Vice President Teare suggested that a tie-in of these conferences with Section Meetings be considered. He also suggested that a Section Meeting might be developed around such a conference.

The Executive Board requested that the Secretary prepare an editorial on the proposal for publication in an early issue of the JOURNAL.

The Executive Board voted that these conferences should have as their primary objective the study of research material in those areas which are likely to be translated into significant engineering practice in the years ahead, in order to clarify such material and reduce it to usable form for engineering teachers.

The Secretary read a letter from Dean Potter, suggesting that finances for such conferences might be obtained from the National Science Foundation.

Humanistic-Social Division Project

The Humanistic-Social Division has requested permission to initiate a project which will consist of a study of the Hammond Report to see what influence it has had on the courses in the social sciences and humanities in engineering education. The study would also investigate programs which seem to have unusual merit. It was proposed to solicit funds from the Ford Foundation to conduct this study.

The Executive Board signified general approval of the project, but requested that the proposal be revised in accordance with cer-

tain recommendations and be presented for approval at the October 14 meeting of the Board.

The Board voted to authorize the President, Vice President in Charge of Divisions, Secretary, and Professor Olmsted to discuss this proposal with officials of the Ford Foundation and the Carnegie Foundation.

Nomination of Officers

The desirability of electing at least one Officer of the ASEE from professional ranks was discussed. The Secretary reviewed the election procedure. Nomination forms are published in two issues of the JOURNAL and sent to Chairmen of all Divisions, Committees, and Sections. The Nominating Committee adds its nominations and then takes a noncommittal preliminary ballot sometime before the Annual Meeting. Final selection of the candidates is made by the assembled Committee at the Annual Meeting and is presented to the membership at a General Session for vote.

It was the opinion of the Board that this method of selecting Officers is better than that used by most societies. The desirability of having multiple candidates was discussed. It was pointed out that in cases where this method is used, there is a tendency to select candidates on the basis of their popularity, rather than performance, and also it would involve the Society in political battles which often place a stigma on the defeated candidates. The Nominating Committee as presently constituted consists of the retiring members of the General Council, who have been elected by the Divisions and Sections. It was the opinion of the Executive Board that there is probably no better group to select the candidates, since they have been working in the Society and are well-acquainted with the qualifications and performance of the leading individuals.

However, it was suggested that it would be appropriate for the Committee on Society Functions to write to the Chairman of the Nominating Committee and suggest that the Committee consider the advisability of selecting a candidate from professorial ranks.

Annual Meeting

Plans for the Annual Meeting were discussed. It was decided to withhold any action until the Committee on Annual Meeting has had an opportunity to formulate its proposals.

Requests for Summer Schools

The Humanistic-Social and Mechanical Engineering Divisions have requested permission to hold Summer Schools.

The Executive Board expressed favorable interest in the Summer Schools, but requested that a definite plan of subject matter be submitted by the Divisions and that action be taken at the October meeting of the Executive Board.

YET Paper Contest

The Executive Board moved to grant $300 in prize money for the YET Paper Contest this year, with prizes of $200, $100 and several Honorable Mentions as determined by the final judging committee.

The rules as adopted are published in this issue of the JOURNAL.

Report of Educational Methods Division

The Educational Methods Division submitted a report in the form of an analysis of articles appearing in the Journal of Engineering Education. This report expressed the opinion that there is room for more research papers dealing in a more penetrating manner with the problems of engineering education. In the discussion, it was pointed out that the articles published in the JOURNAL are limited largely by the material presented at meetings of the Society. Also it was suggested that the proposed conferences in technical areas will help to serve this function. Other projects of an educational research character were discussed by the Board.

The Executive Board voted appreciation of the report and expressed the opinion that this will be helpful in planning future ASEE meetings and activities.

Meeting of Physics Officers of AAPT and ASEE

The Board discussed the request of Dr. Seeger for funds for a meeting of the Physics committees of AAPT and ASEE. These committees are studying the problems of teaching modern physics in the engineering curricula as part of the project of Evaluation of Engineering Education. It

was pointed out that even by stringent use of the funds available, it did not appear that the Committee would have any more than enough to handle the probable expenses.

The Executive Board voted to grant $250, to be charged against Special Projects Funds for travel expenses to attend a joint meeting between the Physics Division of ASEE and AAPT.

Request of Dr. Armsby for Tavel Funds to Engineering Manpower Commission Meetings.

The Executive Board approved the request of Dr. H. H. Armsby for travel funds to attend meetings of the Engineering Manpower Commission as ASEE's representative, inasmuch as he has access to vital information needed by the Manpower Commission.

Request of AIEE for Joint Sponsorship of National Telemetering Conference

The AIEE has proposed a joint conference with ASEE on the subject of telemetering. The Board expressed the opinion that this subject is remote from engineering education and therefore decided not to authorize co-sponsorship.

Associate Institutional Memberships

The Executive Board voted to approve the following Associate Institutional Memberships:

Acme Steel
A. B. Dick Foundation
Allegheny Ludlum Steel Corp.
Armco Steel Corp.
Continental Oil Co.
Dictaphone Corp.
Friden Calculating Machine Co., Inc.
Inland Steel Co.
Minnesota Mining & Manufacturing Co.
Monsanto Chemical Co.
National Cash Register Co.
Ohio Oil Co.
Philadelphia Electric Co.
Pitney-Bowes, Inc.
The Pure Oil Co.
Republic Steel Corp.
Shell Development Co.
Youngstown Sheet and Tube Co.
North American Aviation, Inc.
Ford Motor Comany

The following Associate Institutional Memberships were approved by letter ballot to the Executive Board:

Armour and Company
Boeing Airplane Company
California Research Corporation
Consumers Power Company
Columbia-Southern Chemical Corp.
Columbia Broadcasting System-Hytron Division
Deere and Company
Florida Power Corporation.
General Radio Company
International Harvester
Lockheed Aircraft Corp.
Louisiana Power & Light Company
Lukens Steel Company
Sacony-Vacuum Labs.
Sprague Electric Company
The Toledo Edison Company
Wisconsin Power & Light Company

Breach of commitment by Air Force ROTC

A letter from Dean———to Vice President W. L. Everitt protesting that the Air Force by its reduction of ROTC quotas had committed a breach of faith with students was discussed. It was pointed out that this was necessitated by a reduction in Air Force appropriations. A year ago the ASEE protested the high ROTC quotas and any protest now would be a reversal of this position.

The Executive Board felt that this was a matter of considerable importance and recommended that the ECAC Military Affairs Committee consider the problem and decide if they should present a resolution for the October meeting. It was suggested that the Military Affairs Committee consider conducting a poll of engineering deans as to their opinion on the desirability of protesting the precipitous action of the Air Force ROTC to determine:

1. Do you feel that a moral commitment to the student has been broken by the method of the recent reduction of the Air Force ROTC?

2. Do you desire ASEE to make a protest in the name of the engineering colleges?

Reply should be received by October 14.

Representation at NCSBEE Meeting

Dean W. R. Woolrich was appointed to represent ASEE at the meeting of the National Council of State Board of Engineering Examiners at San Antonio.

Respectfully submitted,

A. B. BRONWELL,
Secretary

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In Memoriam — Alfred Holmes White

Engineering educators all over the country were saddened by the sudden death of Professor A. H. White, former President of the American Society for Engineering Education, in August. Alfred Holmes White, educator and chemical engineer, was born April 29, 1873 in Peoria, Illinois, where he received his early educational training before going on to McGill University for a year. In 1893 he received an A.B. degree with specialization in chemistry from the University of Michigan and in 1904 received his B.S. degree from the same school. In the meantime, he had studied at the Federal Polytechnic School in Zurich, Switzerland in 1896–97 while on leave from the faculty of the University of Illinois.

He joined the University of Michigan faculty as Instructor in Chemical Technology in 1897 and moved successively through academic ranks until he became Head of the Department of Chemical Engineering in 1914 when Edward de Mille Campbell asked to be relieved of the duties. He continued as Chairman until 1942 and became Professor Emeritus of Chemical Engineering in 1943.

Professor White's fundamental work on portland cement, gas and fuel analysis was well-known before World War I. During the war he served in the Ordnance Department and acted as technical director of the Nitrate Division, returning to the University with the rank of Lieutenant Colonel.

Since that time, the department he headed has grown to front rank, with increasing curricula and graduate work. He was one of the most active supporters and had great influence on policy and progress of the Engineering Research Institute at the University, then known as the Department of Engineering Research, organized in 1921 as the contracting agency for sponsored research in engineering and the physical sciences.

Professor White's life-long interest in general education as well as his chosen field of chemical engineering culminated in his Presidency of the Society for the Promotion of Engineering Education (the present American Society for Engineering Education) in 1941–42, a difficult year when war demands were upsetting education, particularly engineering education.

His professional interests are also reflected in his activities in the American Institute of Chemical Engineers where he served as Director, Vice President and President.

His publications include the books "Technical Gas and Fuel Analysis" and "Engineering Materials," the latter a basic engineering text widely used in colleges, some seventy research papers on gas and fuel, hydraulic cements, nitrogen fixation, boiler waters, twenty-eight general papers and thirteen patents.

Education in general and engineering education in particular has lost a most valued and understanding protagonist whose broad perspective in his field is best evaluated when it is realized that his career began with the infancy of chemical engineering as a profession and paralleled the field's growth to its immensely important position today in education, industry and the military.

Section Meetings

Section	*Location of Meeting*	*Dates*	*Chairman of Section*
*Allegheny	University of Pittsburgh		W. I. Short, University of Pittsburgh
Illinois-Indiana	Illinois Institute of Technology	May, 16, 1954	R. G. Owens, Illinois Institute of Technology
Kansas-Nebraska	Kansas State College	Oct. 9–10, 1953	M. H. Barnard, University of Nebraska
Michigan	University of Michigan	May 8, 1954	F. L. Schwartz, University of Michigan
Middle Atlantic	University of Pennsylvania	Dec. 5, 1953	C. Bonilla, Columbia University
Missouri-Arkansas	Missouri School of Mines	April 10, 1954	V. J. Blum, St. Louis University
National Capital Area	Library of Congress	Feb. 2, 1954	C. H. Walther, George Washington University
New England	University of Vermont	Oct. 10, 1953	E. T. Donovan, University of New Hampshire
North Midwest	Marquette University	Oct. 9–10, 1953	A. B. Drought, Marquette University
Ohio	Ohio State University	May 1, 1954	R. S. Paffenbarger, Ohio State University
Pacific Northwest	Oregon State College	April 23–24, 1954	L. Slegel, Oregon State College
Pacific Southwest	San Jose State College	Dec. 29–30, 1953	C. M. Duke, University of California at Los Angeles
*Rocky Mountain	University of Utah		A. Diefendorf, University of Utah
Southeast	North Carolina State College	March 25–27, 1954	J. R. Cudworth, University of Alabama
Southwest	University of Texas	April 16–17, 1954	J. J. Heimerich, University of New Mexico
Upper New York	Rochester Institute of Technology	October 16–17, 1953	F. E. Almstead, State University of New York, Albany

Members of the Society are welcome at all Section Meetings

* No Date Set.

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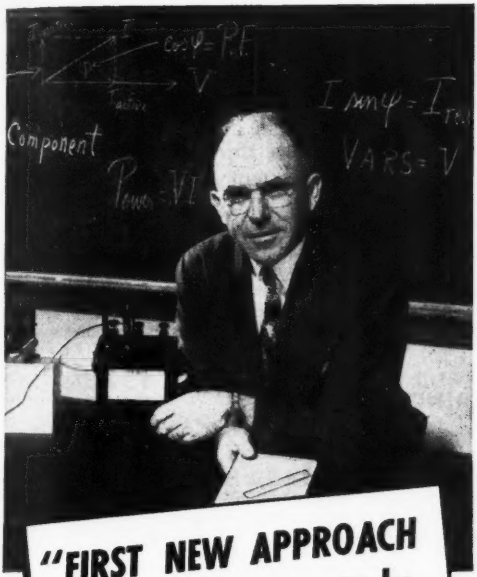

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